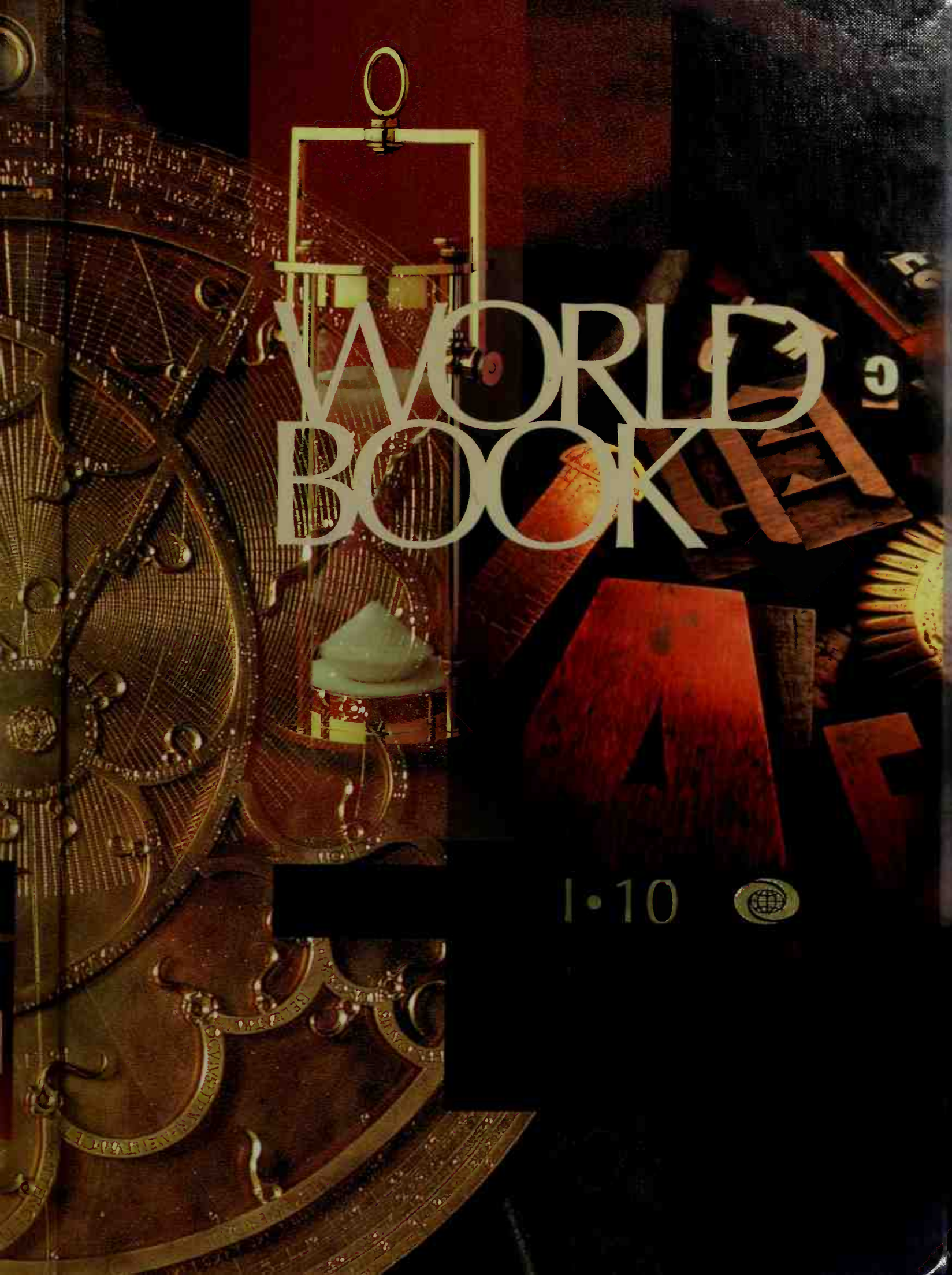
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Ii

I is the ninth letter in our alphabet. This letter also appeared in the alphabet used by the Semites, who once lived in Syria and Palestine. They may have taken its symbol from the Egyptian *hieroglyphic* (picture symbol) for a hand. The Phoenicians later took this letter into their alphabet, and named it *yod,* meaning *hand.* The Greeks took the letter from the Phoenicians, and called it *iota.* See **Alphabet.**

Uses. *I* or *i* is about the seventh most frequently used letter in books, newspapers, and other printed material in English. It is most commonly thought of and used as the first person pronoun. *I* is the symbol for *iodine* in chemistry. As an initial, it may mean, among other things, *international, interstate,* or *independent,* especially in the titles of government agencies. In geographic names, *I* is the abbreviation for *island.* It is the symbol for *one* in the Roman numeral system. In grammar, the abbreviation *i* stands for *intransitive,* as in intransitive verbs.

Pronunciation. In English, a person pronounces *i* with the lips open and the tongue held at the front of the mouth, behind the lower teeth. The letter *i* is a vowel and has several sounds in English. The two most familiar are those in *bite* (long *i*) and *fit* (short *i*). The letter also has two other sounds, as in *machine* (long *e*) and *onion* (*y* sound). In French, the letter has the same long *e* and short *i* sounds. It also has a nasal sound before the letter *n.* This sound is most closely duplicated in English by the *a* in *sang.* Spanish has both the long *e* and *y* sounds. See **Pronunciation.** Marianne Cooley

Development of the letter I

The ancient Egyptians drew this symbol of a hand about 3000 B.C.

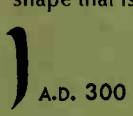
The Semites simplified the symbol for their alphabet about 1500 B.C.

The Phoenicians changed the Semitic letter about 1000 B.C. They named it *yod,* which was their word for *hand.*

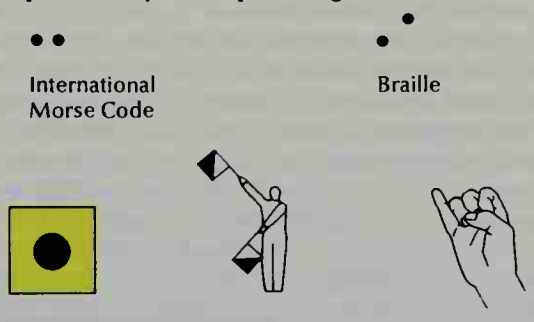
The Greeks, about 600 B.C., made the letter a single stroke called *iota.*

The Romans gave the letter **I** its present shape about A.D. 114.

The small letter i developed about A.D. 300 from Roman writing. Monks who copied manuscripts during the 800's made the letter smaller. By about 1500, the letter had the shape that is used today.

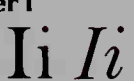


Special ways of expressing the letter I



Common forms of the letter I

Handwritten letters vary from person to person. *Manuscript* (printed) letters, *left,* have simple curves and straight lines. Cursive letters, *right,* have flowing lines.



Roman letters have small finishing strokes called *serifs* that extend from the main strokes. The type face shown above is Baskerville. The italic form appears at the right.

Sans-serif letters are also called *gothic letters.* They have no serifs. The type face shown above is called Futura. The italic form of Futura appears at the right.

Computer letters have special shapes. Computers can "read" these letters either optically or by means of the magnetic ink with which the letters may be printed.

I Ching, *ee jihng,* also spelled *Yijing,* is the earliest and most important book of the ancient Chinese texts called the *Five Classics.* It is also known as the *Book of Changes.* The *I Ching* has also influenced philosophy outside of China, particularly in Japan and Korea.

The *I Ching* probably originated early in the Zhou dynasty (about 1122-256 B.C.). In its earliest form, the *I Ching* was used to predict the future. It contained figures consisting of broken and unbroken horizontal lines. These lines were later combined to form symbolic figures called *trigrams.* As time passed, eight trigrams were created, each representing certain qualities and concepts. For example, three unbroken lines, called the *Qian trigram,* symbolized creativity, strength, heaven, and father.

Eventually, the trigrams were paired to form 64 six-line figures called *hexagrams.* Written interpretations, called *judgments,* explained the general significance of every hexagram. Each line, beginning at the bottom, was given a meaning or message to guide conduct.

A person who wishes to consult the *I Ching* follows a specific ritual which involves tossing special sticks or coins to select a hexagram. The hexagram is then interpreted by referring to the appropriate comments in the *I Ching.* Only a person who possesses extensive knowledge of the *I Ching* can successfully interpret the hexagram.

By the 500's B.C., the *I Ching* had become a book of philosophy instead of a mere fortuneteller's manual. The Chinese philosopher Confucius taught the *I Ching* as a book of moral wisdom. His followers wrote commentaries to the *I Ching* known as the *Ten Wings.* In later Chinese history, the Ten Wings served as the basis for important philosophical theories. David R. Knechtges

Iacocca, *EYE uh KOH kuh,* **Lee** (1924-), was a noted American automobile executive. As chairman of the board of the Chrysler Corporation, Iacocca helped save the company from bankruptcy. He reduced company spending and helped persuade the United States government in 1980 to guarantee $1\frac{1}{2}$ billion in private loans to Chrysler. Chrysler repaid the loans in 1983.

Iacocca began his career in 1946 with the Ford Motor Company. He joined Ford as an engineer but soon switched to sales. In 1960, he became a general manager and vice president. Iacocca headed the team of engineers and designers who developed the Ford Mustang. The Mustang was introduced in 1964, and it quickly became one of the most popular cars ever made. In 1965, he became vice president of Ford's corporate car and truck group. From 1970 to 1978, Iacocca served as president of the company. In 1979, Iacocca was named chairman and chief executive officer of Chrysler Corporation. He retired from this post in 1992. In 1994, he started an investment firm, Iacocca Capital Group.

Chrysler Corporation

Lee Iacocca

Iacocca was born in Allentown, Pennsylvania, and was christened Lido Anthony. He received a B.S. degree from Lehigh University in 1945 and an M.S. degree from Princeton University in 1946.

William H. Becker

Ibadan, *ee BAH dahn* (pop. 1,060,000), is Nigeria's second largest city, after Lagos. It is also the capital of the country's Oyo state. For location, see **Nigeria** (political map). Ibadan is a commercial, educational, and transportation center in the rich agricultural region of southwestern Nigeria. The city's industries include brewing, and the manufacture of canned fruit, cigarettes, paint, and plastics. The University of Ibadan is Nigeria's oldest university. J. F. Ade Ajayi

Iberia, *eye BIHR ee uh,* is the ancient name of the peninsula occupied today by Spain and Portugal. The term *Iberia* is still sometimes used in literature, and geographers refer to the *Iberian Peninsula.* The Iberians were one of the oldest European peoples. They probably came from Africa during prehistoric times. Many other peoples living in Italy, Spain, and Portugal are descended from the Iberians. Other descendants of the Iberians are found as far north as Scotland and Ireland.

Douglas L. Wheeler

Ibert, *ee BEHR,* **Jacques,** *zhahk* (1890-1962), was a French composer. He wrote many works for the stage, including comic operas and ballets. Ibert also wrote music for plays and motion pictures as well as orchestral works and chamber music. His style combines the sometimes contradictory French schools of impressionism and neoclassicism.

Ibert's most famous composition is the orchestral suite *Escales (Ports of Call,* 1924). His *Flute Concerto* (1934) has also been highly praised, and his chamber works for woodwinds are widely performed. Another important work is his ballet *Le Chevalier errant* (written in 1935, first performed in 1950). Ibert's most popular opera is *Angélique* (1927).

Jacques François Antoine Ibert was born in Paris. He was director of the French Academy in Rome from the late 1930's to about 1960, and of the combined Paris Opéra and Opéra-Comique from 1955 to about 1957.

Stewart L. Ross

Iberville, *ee behr VEEL* or *EE bur vihl,* **Sieur d'** (1661-1706), was a French-Canadian trader, soldier, naval officer, and explorer. He fought ruthlessly against the English in North America and founded the colony of Louisiana.

In 1690, during King William's War (1689-1697), Iberville led a party that massacred and looted the English settlement of Schenectady, New York. He captured Fort York on Hudson Bay in 1694 and Fort William Henry on the Atlantic coast of Maine in 1696. That year, he also helped seize St. John's in Newfoundland. In 1697, he again captured Fort York after defeating the English in a spectacular naval battle.

In 1698, France commissioned Iberville to explore the mouth of the Mississippi River and establish a fort nearby. He and his brother Sieur de Bienville reached the mouth of the river in 1699. Iberville then built Fort Maurepas on Biloxi Bay, at what is now Ocean Springs, Mississippi. The fort was completed in 1699. Old Biloxi, the first French settlement in the Mississippi Valley, grew up around Fort Maurepas. In 1706, during the War of the Spanish Succession, Iberville captured and looted the English Caribbean island of Nevis.

Iberville was born in Ville-Marie (now Montreal), the son of wealthy fur trader Charles Le Moyne. His given and family name was Pierre Le Moyne. S. Dale Standen

See also **Bienville, Sieur de; Le Moyne, Charles; Louisiana** (Exploration and early settlement).

Ibex, *EYE behks,* is a wild goat found in the Alps of Europe, the Middle East, Africa, and central Asia's Himalaya . The Alpine ibex is gray or brown, and stands about 35 inches (89 centimeters) high at the shoulder. The male has backward-curving horns that may grow over 30 inches (76 centimeters) long. The female has horns 6 to 8 inches (15 to 20 centimeters) long. The Himalayan ibex is larger than the Alpine ibex. It has long horns, a large beard, and a whitish-colored back. C. Richard Taylor

Scientific classification. The ibex belongs to the bovid family, Bovidae. Its scientific name is *Capra ibex.*

See also **Goat** (picture).

Ibis, *EYE bihs,* is any of more than 20 species of wading birds found in warm regions throughout the world. Ibises range from 18 to 42 inches (46 to 107 centimeters) in length. They have a long neck, long legs, and a long, thin bill that curves downward.

Ibises usually live near water. They eat various small animals, including crayfish, fish, frogs, and insects. Ibises nest in colonies of up to several thousand birds. They build nests of sticks or other plant matter. The females lay three or four eggs that hatch in three or four weeks. Both parents care for the eggs and the young.

The *glossy ibis* inhabits warm areas around the world. It has gleaming purplish and brownish feathers. The brightly colored *scarlet ibis* lives in South America. The *sacred ibis* of Africa is black and white. James J. Dinsmore

Scientific classification. Ibises belong to the ibis family, Threskiornithidae. The scientific name for the white ibis is *Eudocimus albus.* The glossy ibis is *Plegadis falcinellus,* the scarlet ibis is *Eudocimus ruber,* and the sacred ibis is *Threskiornis aethiopicus.*

See also **Bird** (picture: Scarlet ibis).

Ibizan hound, *ee BEE zuhn,* is a rare breed of dog from the island of Ibiza, off the eastern coast of Spain. It is descended from hunting dogs of ancient Egypt brought to Ibiza by merchants. The people of Ibiza used it primarily to hunt rabbits and other game. The breed became popular on the Spanish mainland and eventually spread throughout Europe. It was introduced into the United States in 1956. Today, it is used chiefly for hunting and exhibition.

WORLD BOOK photo

The Ibizan hound is a sleek dog with upright ears.

The Ibizan hound resembles the greyhound. Its most prominent features are a long head; large, upright ears; a pink nose; and amber eyes. It has a long neck and a long, slender tail. Its short, silky coat may be red, white, brown, or a mix of those colors. Some of the dogs have longer coats that are thick and wiry. The dog stands from 23 to 27 inches (58 to 69 centimeters) high at the shoulder and weighs from 42 to 50 pounds (19 to 23 kilograms). Critically reviewed by the American Kennel Club

IBM. See **International Business Machines Corporation.**

Ibn Battuta, *IHB uhn bat TOO tah* (1304–1377?), was a famous Arab traveler and writer. He visited western Europe, western Africa, and the Far East. Ibn Battuta recorded his travels in the book *Rihla (Journey).* Its accounts of Asia Minor (now Turkey), India, and western Africa have long been important to historians.

Ibn Battuta was born on Feb. 24, 1304, in Tangier, Morocco. His full name was Muhammad ibn Abdullah ibn Battuta (also spelled Batuta). He was educated in Islamic law and religion, and began traveling in 1325. Ibn Battuta journeyed first to the city of Mecca in what is now Saudi Arabia. Afterward, his trips included visits to Egypt, Ethiopia, Syria, Asia Minor, Persia (now mainly Iraq, Iran, and Afghanistan), India, Indonesia, and China. In 1349, after 24 years of travel, Ibn Battuta returned to Morocco. But he soon set out again and went to Andalusia, a region in Spain, and to Timbuktu, a center of the Mali Empire in western Africa. Wilferd Madelung

Ibn Khaldun, *IHB uhn khahl DOON* (1332-1406), was an Arab historian. His seven-volume *Universal History* is a monumental study of world civilization. It is considered one of the major historical works of the Middle Ages.

Ibn Khaldun believed states and empires rise and fall in constant cycles. Hard work and cooperation lead to state formation and prosperity. But then tyranny, corruption, and decline set in. He expressed his theories in *Muqaddima,* the first volume of *Universal History.* British historian Arnold J. Toynbee called *Muqaddima* "the greatest work of its kind that has ever yet been created."

Ibn Khaldun described his experiences as a politician, scholar, and statesman in his *Autobiography.* He was born on May 27, 1332, in the North African city of Tunis. He died on March 17, 1406, in Cairo. Aziz Al-Azmeh

Ibn Roshd. See **Averroës.**

Ibn Saud, *IHB uhn sah OOD* (1880?-1953), became one of the most important absolute monarchs of his day. He created Saudi Arabia and became its king in 1932. This nation in southwestern Asia includes Mecca, the holy city of the Muslims, and some of the richest oil fields in the world (see **Saudi Arabia**).

Abd al-Aziz ibn Saud was born in Riyadh in central Arabia. His family, which once ruled much of Arabia, lost influence and was driven from its home in 1891. But, in a daring exploit, Ibn Saud recaptured Riyadh in 1902 and began his career as a leader. He defeated Sharif Hussein, the ruler of Mecca, in 1924. Mecca was in the kingdom of Hejaz, which Ibn Saud added to his conquests. He was proclaimed king of Hejaz in 1926. In 1932, he united all the territories over which he had

gained control into the single kingdom of Saudi Arabia.

Oil was discovered in the eastern part of Saudi Arabia in the early 1930's. Ibn Saud allowed United States oil companies to lease oil fields in his country. Sizable amounts of oil were not produced until after 1945, when World War II ended. Oil exports then climbed to the rate of more than 1 million barrels a day.

In his last years, Ibn Saud grew feeble and almost blind. Two of his sons, Saud and Faisal, handled the affairs of state (see **Faisal**). Sydney N. Fisher

Ibn-Sina. See Avicenna.

Ibsen, Henrik (1828-1906), a Norwegian playwright, is recognized as the father of modern drama. When Ibsen began his career in the mid-1800's, European drama offered little but artificial melodramas and frivolous farces. Popular *well-made plays* featured puppetlike characters and improbable situations filled with coincidence. Through his 26 plays, Ibsen reshaped these old forms with complex characters, lifelike dialogue, believable social and psychological motivation, and stories that addressed important issues.

His life. Ibsen was born in Skien. His merchant father was a leader of local society until bankruptcy in 1835 disgraced the family and forced them to move to a rural cottage outside town. In 1844, Ibsen became a pharmacist's assistant in Grimstad. There, a romance with an older servant resulted in the birth of an illegitimate child in 1846. Several of Ibsen's dramatic themes were probably inspired by these early experiences, notably his emphasis on the hypocrisy of "polite" society, the destructive effects of secret guilt, the burden of the past, and the need for self-reliance.

Ibsen's theater career began with the performance of his second play, *The Warrior's Barrow* (1850). He served as writer-manager of the Norwegian Theatre in Bergen from 1851 to 1857, when he became artistic director of the Christiania Norwegian Theatre in Christiania (now Oslo). In 1858, he married Suzannah Thoresen, whose devotion brought him lifelong emotional security. In 1864, a grant for foreign study began a 27-year period of voluntary exile for Ibsen, mainly in Italy and Germany. During this time, he wrote his most enduring masterpieces. He returned permanently to Christiania in 1891.

His plays. Ibsen's first period (1850-1873) consists mainly of verse dramas, most based on Norwegian history and folk literature. The best are *Brand* (written in 1865), a symbolic tragedy, and *Peer Gynt* (written in 1867), a fantasy.

Ibsen's most popular works today are the prose "problem plays" of his second period (1877-1891). They are realistic studies of small-town life. In them, Ibsen exposed the deceptions and corruption that he saw in middle-class society. *A Doll's House* (1879) explores the oppression of women. *Ghosts* (1882) portrays the terrible cost of inherited guilt. *An Enemy of the People* (1883) deals with community suppression of a truth that it finds inconvenient. *The Wild Duck* (1885) deals with the relative merits of reality and illusion. *Hedda Gabler* (1891) concerns the psychological dangers of social and sexual repression.

The plays of Ibsen's last period (1892-1900) reintroduced the heightened symbolic intensity of the playwright's early work. They reveal Ibsen's mystical side, especially his interest in the workings of the unconscious and the individual's struggle to achieve self-realization. The plays of this period are *The Master Builder* (1893), *Little Eyolf* (1895), *John Gabriel Borkman* (1897), and *When We Dead Awaken* (1900). Frederick C. Wilkins

See also **Drama** (Ibsen).

Additional resources

McFarlane, James, ed. *The Cambridge Companion to Ibsen.* Cambridge, 1994.

Meyer, Michael L. *Ibsen.* 1974. Reprint. Penguin, 1985.

Ibuprofen, *eye BYOO proh fehn* or *EYE byoo PROH fehn,* is a drug that reduces fever and relieves such common problems as headaches, muscle aches, and menstrual pain. It also reduces the swelling and tenderness of inflammation due to arthritis and other conditions. Ibuprofen works by blocking the formation of *prostaglandins,* hormonelike chemicals found throughout the body (see **Prostaglandin**).

Many people take ibuprofen instead of aspirin because it is thought to cause fewer side effects. But like aspirin, ibuprofen can irritate the stomach and cause minor stomach bleeding and nausea. People who are allergic to aspirin are also usually allergic to ibuprofen.

Ibuprofen is the most widely used of a group of drugs called *propionic acid derivatives.* These drugs were developed during the 1960's and early 1970's. At first, ibuprofen could be obtained only with a doctor's prescription. In 1984, the United States Food and Drug Administration (FDA) permitted the sale of ibuprofen without a prescription. The drug's trade names include Advil, Nuprin, and Motrin. Eugene M. Johnson, Jr.

Icarus. See **Daedalus.**

Ice is frozen water. Low temperatures cause ice to form on lakes and rivers and on wet streets and sidewalks. Snow, sleet, frost, and hail are ice, and so are glaciers. Even in summer, ice may be present in high clouds.

How ice is formed

At 60 °F (16 °C), water completely fills the container at the right. The water molecules move about randomly.

At 39 °F (4 °C), the water contracts and fills only part of the container. The molecules move closer together.

At 32 °F (0 °C), the water freezes into ice and expands. The molecules move apart and form a rigid pattern of crystals.

WORLD BOOK diagram by Steven Liska

High clouds are composed of ice crystals.

Ice is plentiful throughout the universe. Ice is the main component of comets, which are much like dirty, loosely packed snowballs. Some of Jupiter's moons, including Europa and Ganymede, may have layers of surface ice.

Properties of ice. Pure water freezes at 32 °F (0 °C). Water that contains other substances, such as alcohol, salt, or sugar, freezes at a lower temperature. For this reason, road crews put salt or other chemicals on icy streets in order to melt the ice and make the roads less slippery.

Ice is slippery because, even at temperatures slightly below 32 °F, it has a thin, liquidlike surface. Unlike the molecules within the crystal, the surface molecules are arranged in a disorderly way, and they vibrate rapidly. The liquidlike layer thus acts as a lubricant. An ice skater does not skid during a turn because the pressure and friction of the skate blades melt a narrow groove in the ice.

Ice attaches itself strongly to objects on which it forms. This property can be an annoyance when ice sticks to an automobile windshield. It can be a danger when ice sticks to airplane wings.

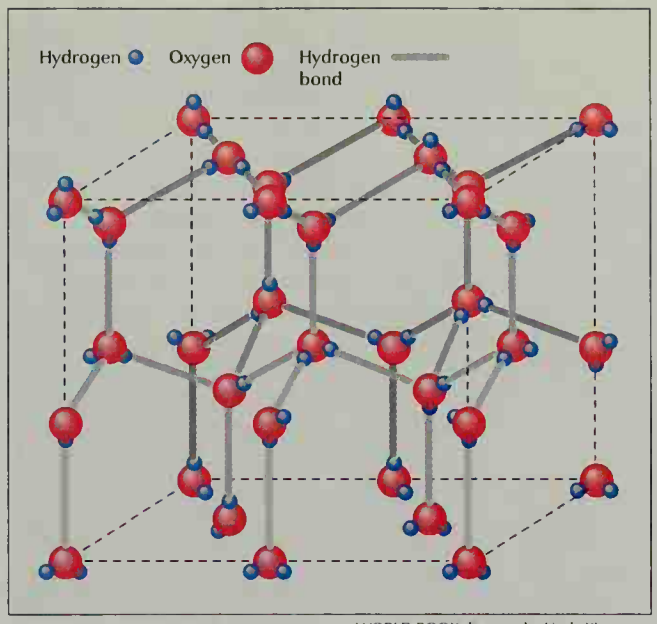
One property of ice is rare in nature: A volume of ice weighs less than the same volume of water. That is, ice is less *dense* than water. By contrast, the solid form of most substances is denser than the liquid form. Most liquids *contract* (decrease in volume) as they cool and freeze. When pure water cools below 39 °F (4 °C), however, it expands until it freezes at 32 °F (0 °C). Because of ice's low density, it floats on water instead of sinking. Without this property, ice would form on the bottom, rather than on the top, of lakes and rivers.

Water's changes in volume can have harmful results. The expansion of freezing water in pipes may cause the pipes to burst. The expansion and contraction of freezing and thawing water within the pavement of a road can cause the pavement to crumble.

The structure of ice is responsible for the expansion of water at low temperatures. Pure ice has a regular crystal structure of frozen water molecules. Each molecule consists of one oxygen (O) and two hydrogen (H) atoms, or H_2O. Each molecule is attached to four neighboring molecules by connections known as *hydrogen bonds*. The bonds extend from the oxygen atom of one molecule to the hydrogen atom of another. Each oxygen atom can be part of two hydrogen bonds, and each hydrogen atom can participate in one hydrogen bond. Thus, each molecule can form four bonds. The bonds are long, and they point away from one another.

Molecules of pure water behave normally until they are cooled below 39 °F. When any liquid is warm, the energy of its molecules causes the molecules to collide. The recoil from the collisions tends to keep the molecules a certain distance apart. As the liquid cools, the molecules become less active. Collisions occur less often and are less energetic. As a result, the molecules draw closer together, and the liquid contracts.

Most liquids continue to contract when cooled below 39 °F. As water is cooled below that temperature, however, hydrogen bonds begin to form, pushing molecules apart. The water expands. When water freezes to form ice, the network of hydrogen bonds is completed.



WORLD BOOK diagram by Linda Kinnaman

An ice crystal consists of water molecules, each made up of one oxygen atom and two hydrogen atoms. Chemical forces called *hydrogen bonds* join each oxygen atom to the hydrogen atoms of two other molecules. Except for the atoms on the crystal's surface, all the atoms are bonded in this way.

The water suddenly expands further and hardens.

Ice sticks strongly to other objects because the molecules on the surface of the freezing water can form only three hydrogen bonds with other water molecules. The surface molecules form the fourth bond with molecules of the other object.

The length and direction of ice's hydrogen bonds give ice crystals an open structure. Because of this structure, ice deforms when squeezed. When scientists subject ice to tremendous pressures in the laboratory, the ice forms crystal structures that are more compact than ordinary.

Ice "cages." Much ice contains small molecules of other substances trapped within its open crystal structure. This kind of ice is known as a *clathrate hydrate (KLATH rayt HY drayt)* or a *gas hydrate*. Large deposits of ice containing carbon dioxide, natural gas, and other substances occur on the ocean floor. Many scientists believe that natural gas hydrates may provide a future source of energy.

Much of the ice that covers polar regions consists of clathrate hydrates. Climate researchers have drilled cores from the ice and analyzed the gas molecules trapped at different depths. In general, deeper material was deposited earlier. The cores thus provide a record of climate changes, volcanic eruptions, and other events of the past 100,000 years that produced the gases.

Although large deposits of clathrate hydrates exist, ice more commonly excludes impurities as it crystallizes, even in highly contaminated water. Water molecules tend to bond to one another, rather than to impurities. Because of this tendency, ice formed from seawater contains almost no salt. Thus, freezing is a valuable process for the purification of water.

J. Paul Devlin

Related articles in *World Book* include:

Dry ice	Glacier	Iceberg
Freezing point	Hail	Refrigeration
Frost	Ice age	Snow

Ice age is a period in the earth's history when ice sheets cover vast regions of land. Ice ages alternate with *interglacial periods,* when the ice sheets mostly disappear. An ice age generally lasts about 100,000 years; an interglacial period, from 10,000 to 20,000 years. The most recent ice age ended about 11,500 years ago. Most earth scientists expect that another ice age will follow the interglacial period in which we now live.

Ice ages occur during times known as *glacial epochs.* The earth has had several glacial epochs. Each lasted from 20 million to 50 million years. The earliest known ice ages occurred as long as 2.3 billion years ago. Three major glacial epochs took place between about 900 million and 600 million years ago. There were two more about 450 million and 300 million years ago. The most recent one occurred mainly during the Pleistocene Epoch, a time that began around 2 million years ago and ended about 11,500 years ago. The term *Ice Age,* if capitalized, usually refers to the Pleistocene glacial epoch, when numerous separate ice ages occurred.

Development of the Pleistocene glaciers. About 55 million years ago, the earth's atmosphere began to cool. Glaciers started to form in Antarctica about 38 million years ago. They grew rapidly about 13 million years ago, forming the Antarctic ice sheets. These sheets have buried almost all of Antarctica for the last 5 million years. About 7 million years ago, ice sheets began to form in North America, Europe, and Asia. By 2.5 million years ago, they covered vast areas.

Extent of the Pleistocene glaciers. Scientists have determined the shape and size of the ice sheets mainly from traces left by the ice as it flowed outward under the pressure of its own weight. On rocks over which the ice moved, it left *striae* (scratches). Valley glaciers gouged out U-shaped gorges in former river valleys. When glaciers melted, they left behind soil and rocks, often in mounds and ridges, called *moraines.* Low places that had been scoured out by the ice filled up with water, forming lakes and fiords.

Scientists have also measured changes in the ground level to determine the extent of the glaciers. The great pressure of the ice in the center of the sheets pushed the underlying rock down. Rock along the edges of the sheets reacted by bending upward. As the ice melted, rock under the center rose, and rock along the edges sank. Some of this adjustment is still occurring.

The most recent Pleistocene glaciers reached a depth of about 10,000 feet (3,000 meters). When they were at their greatest extent, so much water was frozen in them that the sea level was at least 330 feet (100 meters) lower than it is now.

The center of the main ice sheet in North America was near Hudson Bay in Canada. This sheet covered large parts of North America, south to about the present valleys of the Missouri and Ohio rivers.

The Scandinavian Peninsula was the center of the main sheet in Europe. This sheet reached into northern Germany and almost to Moscow. It was about half the size of the North American sheet.

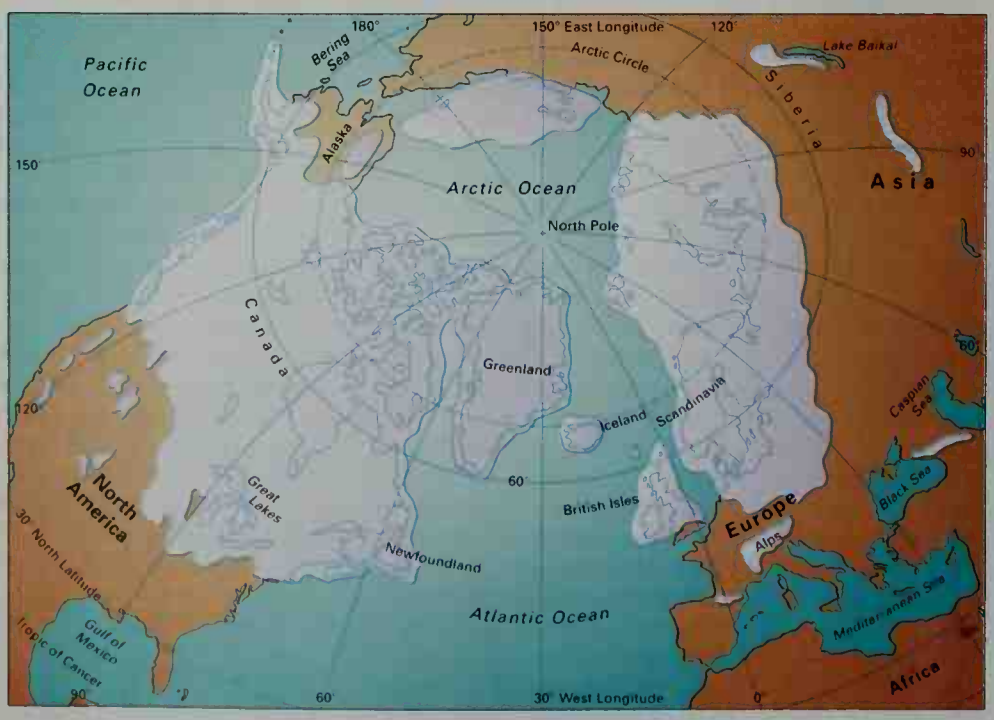
The glaciers last began to retreat less than 20,000 years ago. Today, only Antarctica and Greenland are almost completely covered by glaciers.

Evidence of ice ages and their climates. During the Pleistocene Epoch, as many as 18 ice ages may have occurred. Each ice age consisted of many warmer and colder times of varying length and intensity. The amount of ice also varied. Sources of evidence of the various ice ages and their climates include *sediments* (deposits of mud and other matter) on land and in the oceans, and today's glaciers and ice sheets.

Evidence from land was the basis of the earliest descriptions of Pleistocene ice ages. This evidence included striae on rocks and some huge boulders deposited far from their place of origin. By the mid-1800's, many scientists believed that the evidence resulted from the movement of glaciers that had covered vast areas of Europe and North America. By the late 1800's, researchers concluded that certain moraines and other material left

The last ice age

In the most recent ice age, which ended about 11,500 years ago, ice sheets covered vast areas in the Northern Hemisphere. During their farthest advance, *shown on this map,* the ice sheets covered what are now the Scandinavian countries and other northern parts of Europe, and most of Canada. Ice sheets also covered Antarctica, but they were less extensive in the Southern Hemisphere.



Greatest extent of ice sheets

0 1,000 2,000 Miles
0 1,000 2,000 Kilometers

WORLD BOOK map

behind by glaciers in North America resulted from four ice ages. They named these ages the *Nebraskan, Kansan, Illinoian,* and *Wisconsin.*

An analysis of river terraces on the north slope of the Alps mountain system in Europe led to the identification of four ice ages in Europe. The terraces are composed of layers of gravel. Scientists concluded that rivers had deposited the gravel when the climate was cold. At such times, the action of frost readily breaks up rock, forming gravel. Also, there is not much vegetation, so there are relatively few plant roots to hold broken rock in place. As a result, runoff from rainfall carries much gravel to streams and rivers.

Scientists named the ice ages the Günz, Mindel, Riss, and Würm, after four rivers in the area that had been studied. No one knows exactly how the older ice ages fit into the sequence of about 18 Pleistocene ice ages.

Further evidence of ice ages occurs in sediment near the mouths of rivers. Researchers discovered that, in some river mouths, sediment had built up at least four different times. Before each build-up, the rivers had washed away most of the older sediment.

The researchers concluded that the times of sediment build-up were interglacial periods. The sea level was high during those times due to runoff from melted glaciers, and the sea flooded the mouths of river valleys. The flow at the river mouths therefore was slow. As a result, sand, silt, and other material in the water sank to the river beds, building interglacial sediments. The times of sediment washout were ice ages. The sea level was low. The rivers therefore flowed swiftly, scrubbing out the sediment.

The record of river deposits is valuable but incomplete. The sediments represent only a small fraction of the time in which glacial epochs have occurred. Furthermore, due to erosion, little or nothing remains of the oldest deposits.

Information on ice age climate also comes from deposits of *loess* (fine, wind-blown dust), lake sediments, and *bogs* (wetlands containing partially decayed plant and animal matter). Scientists examine a deposit for pollen and remnants of plants and animals. They then analyze their specimens according to two factors: (1) the depth at which they found the specimens, and (2) the climate in which the same species grow today.

The depths at which specimens are found indicate when the specimens were deposited. In general, deeper material was deposited earlier. The comparison with present growth patterns indicates what the climatic conditions were when the specimens were deposited.

Evidence from oceans comes from *cores* (cylindrical samples) drilled out of sediment in the ocean floor. For example, researchers count the shells of different kinds of tiny ocean-dwelling animals called *foraminifera* found at various depths in the cores. Some of these species grow well in warm water, while others grow well in cold water. By comparing the numbers of the species at a given depth, researchers estimate the temperature of the water when the specimens were deposited.

Scientists determine how much ice was locked in glaciers and ice sheets by measuring the *isotopes* (forms) of oxygen in foraminifera shells. Two isotopes of oxygen occur most often in nature. One of them, known as O-18, is heavier and much rarer than the other, O-16.

Rich Reid, Earth Scenes

Remnants of the last ice age still exist in Alaska in the form of glaciers, *shown here.* These large, slow-moving bodies of ice flow from mountaintops and merge like rivers. As they creep to the sea, the glaciers scour out deep valleys.

A water molecule (H_2O) consists of two atoms of hydrogen (H) and one atom of oxygen (O). Water molecules with O-16 evaporate more readily than do water molecules that have O-18. The O-16 isotope therefore accumulates in snow and ice sheets, while O-18 stays more in the ocean. Thus, during ice ages, when the sea level was low, the ocean had a higher percentage of O-18 than during interglacial periods.

The shells of foraminifera contain carbonate (CO_3), which consists of one atom of carbon (C) and three atoms of oxygen (O). Foraminifera obtain the oxygen for their carbonate from the ocean water. Thus, foraminifera that lived during ice ages accumulated a higher percentage of O-18 in their shells than did foraminifera that lived during interglacial periods.

Evidence from today's glaciers. The best and most detailed evidence of ice age climate comes from cores of ice drilled in Greenland and Antarctica. Scientists drilled two cores in Greenland to a depth of about 10,000 feet (3,000 meters). The cores provide a reliable record of the temperature, chemical activity, dust concentration, and gas composition of the atmosphere for the last 100,000 years.

The evidence indicates that large variations in the climate of Greenland occurred frequently during the last ice age. The climate changed rapidly—often in a few decades, sometimes in a few years. Ocean processes may have caused these changes. For example, warm currents in the Atlantic Ocean may have shifted, causing ice sheets to decay. Pieter M. Grootes

See also **Earth** (Why ice ages occur); **Glacier; Loess; Moraine; Prehistoric animal** (The ice ages).

Additional resources

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Ice cap. See Icecap.

Ice cream is a popular frozen dairy food. It consists mostly of milk products, sugar, and flavorings. Ice cream may be served by itself or with cake, pie, or other pastries. It also is used in making milk shakes, sodas, cake rolls, and sundaes. Manufacturers make ice cream in many flavors. About one-third of the ice cream sold in the United States is vanilla. Chocolate and *Neapolitan* (layers of different flavors) rank next in popularity.

The United States produces about 900 million gallons (3.4 billion liters) of ice cream annually. Almost one-tenth of the nation's milk supply is used to produce ice cream and other frozen desserts. These desserts include ice milk, sherbet, and frozen yogurt. About 7 quarts (6.6 liters) of milk are needed to make 4 quarts (3.8 liters) of ice cream.

Ice cream is served in many parts of the world, but Americans eat more of it than do the people of any other country. Americans eat an average of about 15 quarts (14 liters) of ice cream annually.

The composition of ice cream. The milk products in ice cream make it rich in calcium, phosphorus, protein, and vitamin A. Ice cream is also high in calories because of the carbohydrates and fats it contains, and so it is a good source of energy.

The Food and Drug Administration (FDA) and the individual U.S. states have established standards for the content of ice cream and related frozen desserts. For example, milk fat and other milk solids must make up at least 20 percent of the weight of ice cream. Ice milk consists of a minimum of 11 percent milk solids. Frozen custard, also called French ice cream and French custard ice cream, has the same ingredients as ice cream, plus 1.4 percent egg yolk solids.

Sherbet contains about twice as much sugar as does ice cream, plus a minimum of 2 percent milk solids. Frozen yogurt contains milk fat and other milk solids. Frozen yogurt producers *ferment* (ripen) these milk products by adding bacteria that change milk sugar into acid.

How ice cream is made. Most of the ice cream consumed today comes from commercial manufacturing sources. But some people still enjoy making their own ice cream at home. The first step in making ice cream consists of combining the two chief ingredients—milk products and sugar—to form a *mix*.

Commercial production. In an ice cream plant, the mix is blended in a huge vat and then pasteurized. Next, the mix is homogenized, a process that breaks down the fat particles. Homogenizing the mix helps give ice cream a smooth texture. The mix is then pumped through a cooler, where its temperature drops to about 35 °F (2 °C). Then it is put into a storage tank for three or four hours to "age." Flavorings and colorings are added, and then the mix is frozen.

Most commercial freezers use liquid ammonia to maintain a temperature of about −22 °F (−30 °C). The mix freezes against the sides of the freezer, which has fanlike blades that rotate at a high speed. The blades scrape the frozen mix from the sides of the freezer and whip air bubbles into it. If air were not added, eating ice cream would be like chewing sweetened ice cubes. The air increases the volume of the mix. The difference in volume before and after air is added is called *overrun*. Ice cream packaged for home use has about 80 percent overrun. Sherbet has about 35 percent overrun.

There are two types of commercial freezers. Most manufacturers use a *continuous freezer*, which freezes the mix in less than a minute. The other type, called a *batch freezer*, freezes it in three to eight minutes.

Fruit, nuts, and candy may be added to ice cream before it is packaged. After packaging, the product is placed in a hardening room. Hardening takes at least 12 hours at temperatures ranging from −10 to −20 °F (−23 to −29 °C). Most of the water in the ice cream freezes during this period, so that the product becomes hard for storage.

Home production. Homemade ice cream has less overrun and is not as smooth as commercial ice cream. Most home ice cream makers hold from 4 to 8 quarts (3.8 to 7.6 liters) of mix. Freezing temperatures are created by placing the mix in a freezing compartment surrounded by salt and cracked ice, with a temperature of around 23 °F (−5 °C). The mix is stirred by blades driven by a hand crank or by electric power.

Another type of ice cream can be made in an ice cube tray of a refrigerator. The mix is poured into the tray. After partially freezing, it is scraped out and put into a cold mixing bowl. Then the mix is beaten with an electric mixer, returned to the tray, and put in the freezer compartment of the refrigerator for hardening.

History. No one knows when ice cream was first

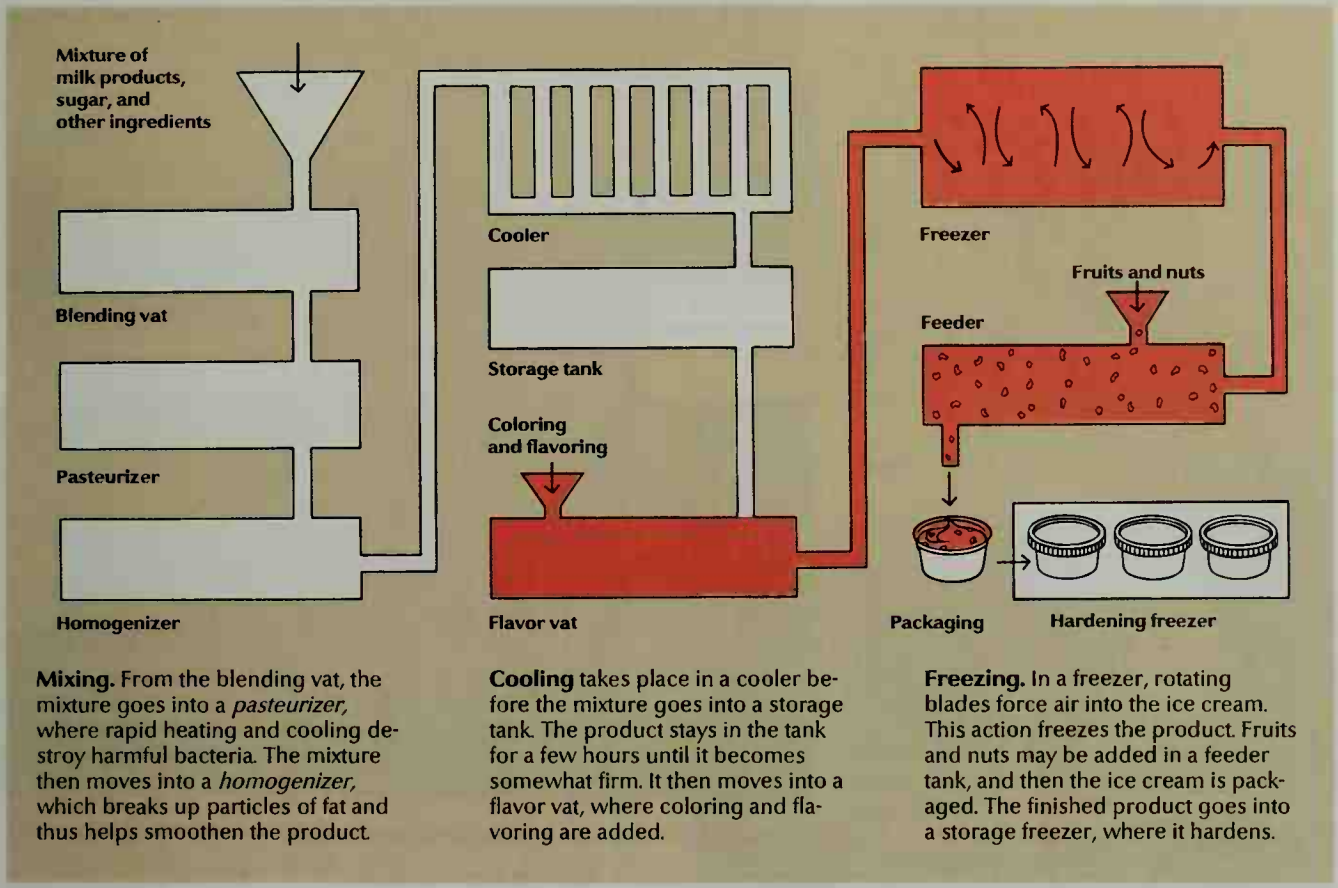
Bresler Ice Cream Company (WORLD BOOK photo)

Ice cream ranks as one of the most popular dessert foods. Complex machines, such as the packaging unit shown above, produce most ice cream. Some people make ice cream at home.

How ice cream is made

Ice cream consists chiefly of milk products, sugar, and flavorings. Ingredients called *emulsifiers* and *stabilizers* hold the mixture together. All the ingredients of ice cream are carefully blended together in a large vat at the beginning of the manufacturing process.

WORLD BOOK diagram



Mixing. From the blending vat, the mixture goes into a *pasteurizer,* where rapid heating and cooling destroy harmful bacteria. The mixture then moves into a *homogenizer,* which breaks up particles of fat and thus helps smoothen the product.

Cooling takes place in a cooler before the mixture goes into a storage tank. The product stays in the tank for a few hours until it becomes somewhat firm. It then moves into a flavor vat, where coloring and flavoring are added.

Freezing. In a freezer, rotating blades force air into the ice cream. This action freezes the product. Fruits and nuts may be added in a feeder tank, and then the ice cream is packaged. The finished product goes into a storage freezer, where it hardens.

made. In 1295, the Italian trader Marco Polo returned to Europe from China and may have brought recipes for water ices. During the 1600's, Europeans used a combination of ice, snow, and a mineral called *saltpeter* to freeze mixtures of cream, fruit, and spices.

British colonists probably brought recipes for ice cream to America in the early 1700's. Ice cream became a popular luxury food, but people had to make it themselves at home until 1851. That year, Jacob Fussell, a Baltimore milk dealer, established the first ice cream plant. Ice cream became one of America's favorite foods during the early 1900's after soda fountains introduced sodas, sundaes, and other new ways of serving it. Ice cream cones were first served at the 1904 World's Fair in St. Louis, Missouri, and ice cream bars appeared in 1921.

Critically reviewed by the International Ice Cream Association

Ice hockey. See Hockey.

Ice plant is the common name for a group of hardy plants that live in dry regions. Glistening hairs cover many kinds of ice plants. From a distance, these hairs resemble ice crystals. The thick leaves of ice plants store water, enabling the plants to withstand drought. Their attractive flowers have numerous petals that may be white, pink, purple, or yellow. Ice plants use their creeping stems to spread over large areas.

Most ice plants are native to South Africa, but people have cultivated them around the world. The best-known kind is the *common ice plant.* The leaves of the common ice plant are edible. However, the plant contains small amounts of a mild poison, which give it a bitter taste. Ice plants have been widely planted in California to control erosion. They have spread so aggressively there that they threaten to crowd out many native plants.

© Richard Shiell, Earth Scenes

Beautiful ice plant flowers have many delicate petals.

George Yatskievych

Scientific classification. Ice plants are members of the fig-marigold and carpetweed family, Aizoaceae. The scientific name of the common ice plant is *Mesembryanthemum crystallinum.*

Royden Hobson

A speed skater racing over a course

Leonardi

Figure skaters competing in a world championship meet

Robert Glaze, Artstreet

Professional skaters performing in an ice show

Ice skating is a competitive sport, a dazzling entertainment in ice shows, and a form of recreation. Athletes compete in *speed skating* or *figure skating* events. Professional figure skaters appear in ice shows. Recreational skaters enjoy skating outdoors or on indoor rinks.

Ice skating

Ice skating is the act of gliding over a smooth surface of ice on ice skates—boots with attached metal blades. For hundreds of years, people could ice-skate only during the winter months in cold climates. They skated on natural ice surfaces, such as frozen canals, lakes, ponds, and rivers. Today, machines produce ice in indoor rinks, making ice skating a form of recreation that can be enjoyed throughout the year.

People of almost any age can enjoy ice skating as healthful and relaxing exercise. Skaters use most of the body's muscles, especially the leg muscles. Skating helps blood circulation by strengthening the heart.

Ice skating is an important competitive sport as well as a popular form of recreation. Athletes compete in two kinds of ice skating—*figure skating* and *speed skating*. Figure skaters perform leaps, spins, and other graceful movements, usually to music. Speed skaters compete in races of various distances. Many young people and adults also play hockey, a fast, rugged sport in which the players wear ice skates. Millions of people attend ice shows each year. Ice shows are colorful spectacles that often feature champion figure skaters.

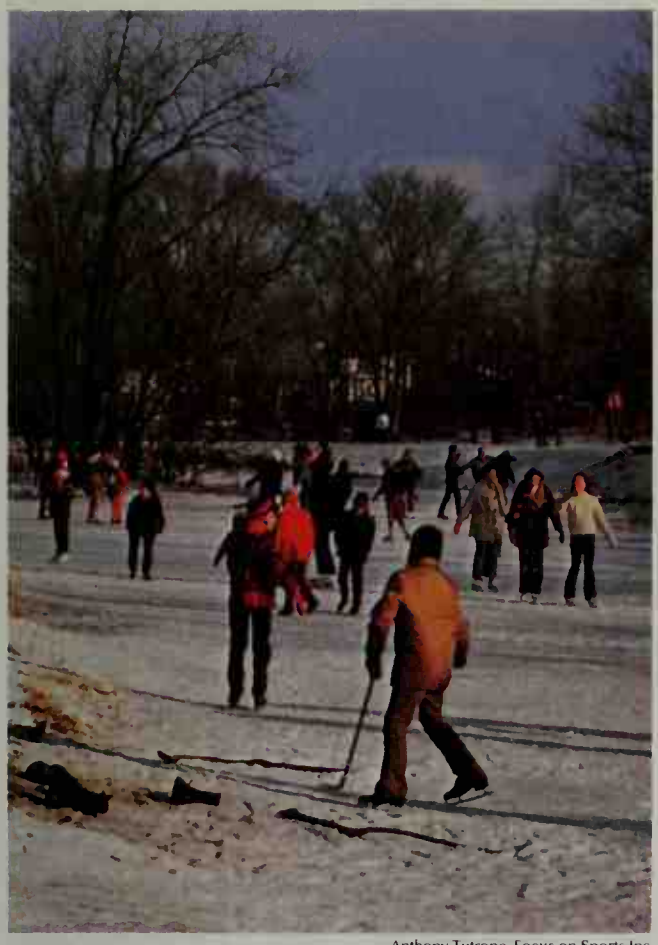
This article describes safety rules for recreational skaters. It then discusses figure skating and speed skating as competitive sports. For information on hockey, see **Hockey**.

The contributors of this article are Nicholas A. Paulenich, Public Relations Director of U.S. Speedskating; and Kristin Matta, Director of Development for the United States Figure Skating Association.

Skating safety

Use of the right equipment is essential to skating safety. The boots should fit properly—that is, they should be snug but not too tight. The blades should be attached securely to the boots and correctly positioned to distribute the weight of the body evenly over the blades. Figure skaters, speed skaters, and hockey players use different types of skates. Many beginning skaters use figure skates. The boot has a high top for good ankle support. In addition, the design of the blade enables beginners to maneuver more easily than they could on speed or hockey blades.

Before going onto the ice, you should lace your boots properly, whether you are a beginning or experienced skater. Proper lacing provides needed support for the ankles. Lace each boot as tightly as possible in front of the ankle. Lace the boot more loosely near the top, leaving enough room to slip a finger through the top. Never



Anthony Tutrone, Focus on Sports Inc.

Recreational skaters having fun on a frozen river

skate, or even walk, in unlaced boots. Unlaced boots can result in a fall and a serious injury.

Skating on a natural ice surface is more dangerous than skating on an indoor rink or on an artificially created outdoor rink. The great danger is the risk of falling through thin ice. Therefore, never skate on a natural ice surface that is less than 4 inches (10 centimeters) thick. And never skate alone on natural ice. Always make sure a ladder and a rope are available for rescue purposes. To rescue a skater who has fallen through the ice, lie on the ladder as close as possible to the hole. The ladder spreads your weight evenly over the ice and prevents you from falling through. Use the rope to pull the skater to safety. You may also use the rope as a lifeline. Tie one end to a tree or to someone on shore and tie the other end around your waist before attempting a rescue.

Rinks generally attract more skaters than do natural ice sites, which increases the chance of collisions. For this reason, rinks forbid fast skating and require all skaters to move in the same direction.

Figure skating

Figure skating competitions are held on a rink about 200 feet (60 meters) long and 100 feet (30 meters) wide. The rink has gently rounded corners and is surrounded by a barrier about 4 feet (1.2 meters) high.

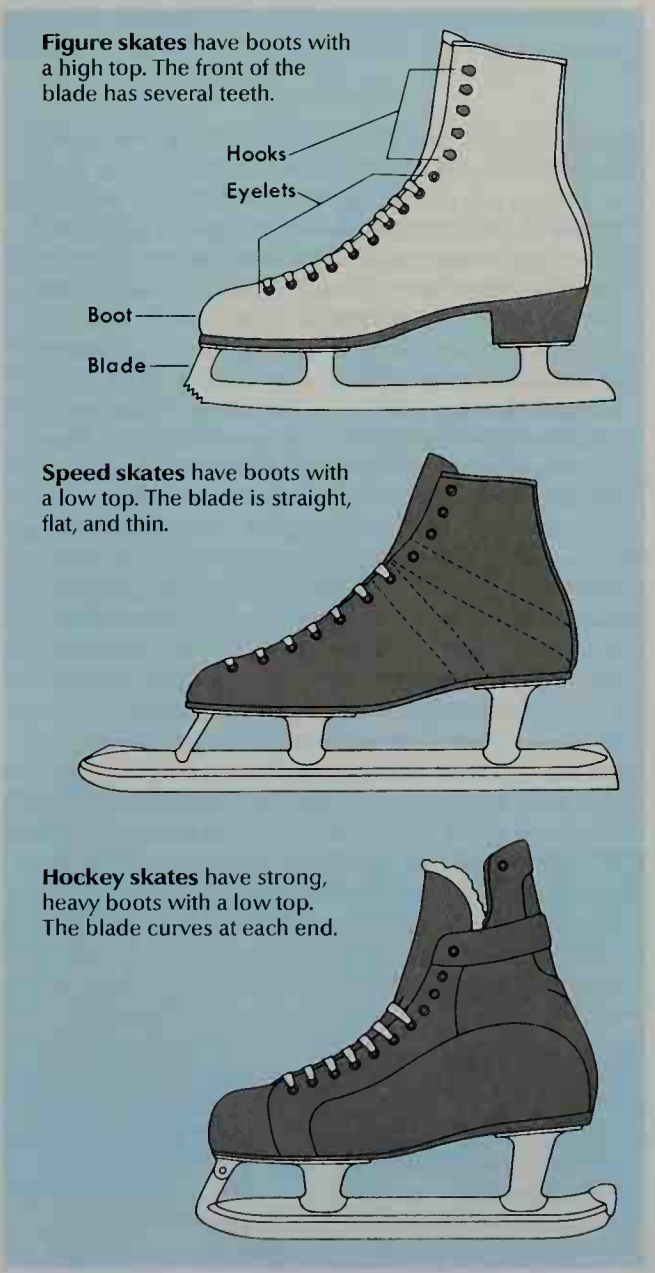
Figure skates have a special blade that enables competitors to perform the difficult moves required in figure skating. The blade is $\frac{1}{2}$ inch (3 millimeters) thick and about 12 inches (30 centimeters) long. The blade has an inside and an outside edge. Skaters skate on one edge at a time. The bottom of the blade is slightly curved inward. This curve permits only a small part of the blade to touch the ice at one time, enabling a skater to maneuver more easily. The front of the blade has several teeth called *toe picks*. Skaters use the toe picks to bite into the ice when performing certain jumps and spins. The boots of figure skates have a high top.

Figure skaters wear costumes that are comfortable and attractive and that permit freedom of movement. Women generally wear a simple dress with a short skirt and matching tights. The men usually wear close-fitting, comfortable pants with a matching shirt.

Figure skaters may take part in (1) singles skating, (2) pair skating, (3) ice dancing, and (4) synchronized skating. Men and women compete separately in singles skating, but they follow similar rules. In pair skating and ice dancing, teams consisting of a man and a woman

Types of ice skates

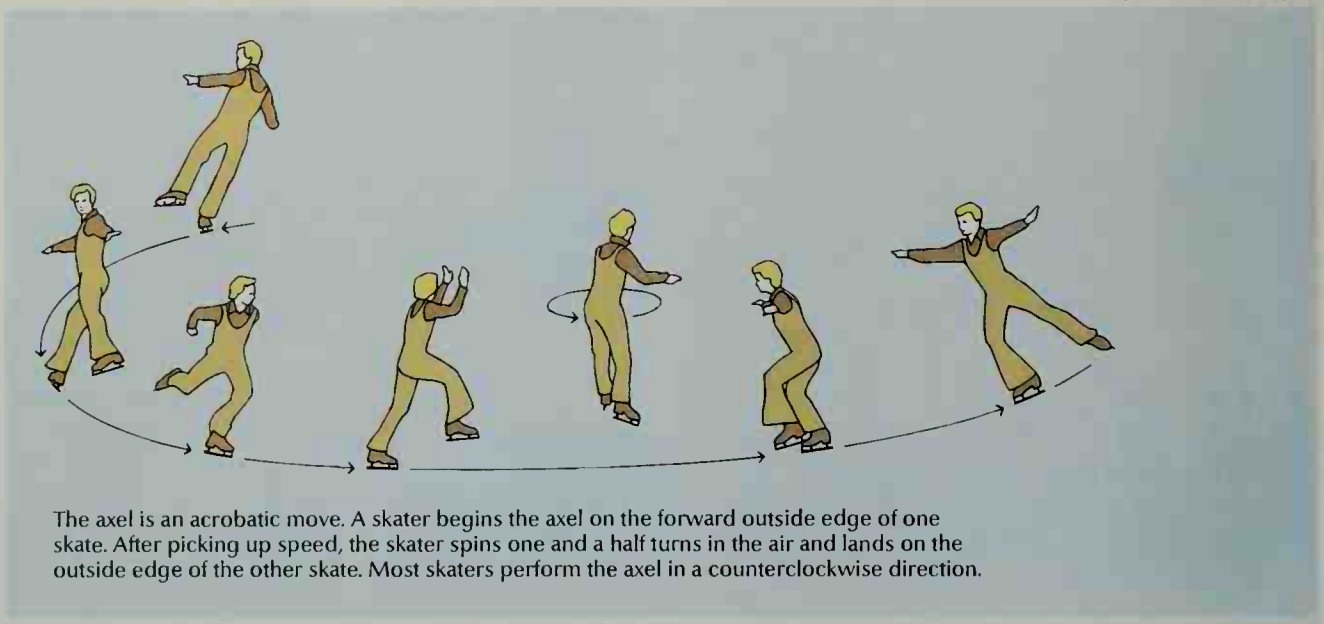
WORLD BOOK diagram by Robert Keys



Basic figure skating moves

A person must master certain moves to become a skilled figure skater. This diagram illustrates the *axel,* one of the basic moves in figure skating.

WORLD BOOK diagrams by David Cunningham



The axel is an acrobatic move. A skater begins the axel on the forward outside edge of one skate. After picking up speed, the skater spins one and a half turns in the air and lands on the outside edge of the other skate. Most skaters perform the axel in a counterclockwise direction.

compete against one another. Precision skating involves groups of 12 to about 24 skaters that compete as teams. The teams try to perform as a unit rather than as soloists.

Figure skaters compete at various levels, depending on their skill. Skaters must pass proficiency tests to advance to a higher level. The highest is the senior level.

Judges score all events on a scale of 0 to 6 points, with 6 being the highest score. They carry the skaters' scores to one decimal place, as in a score of 3.7.

Singles skating consists of two parts in both men's and women's competition. They are the short program and the free skating program, also known as the long program.

The short program counts one-third of the skater's total score. It consists of eight required moves or elements: three jumps, three spins, and two fast step sequences or footwork. All skaters perform the same moves or elements. The moves may be done in any sequence with a 2-minute 40-second time limit. The moves are performed to music selected by the skater.

Each skater receives two scores. The first score reflects the required elements of the skater's program—that is, how accurately the skater performed the moves. The second score reflects the program's artistic impression, which evaluates the overall program, including its choreography, artistry, and expression.

The free skating program accounts for two-thirds of the skater's score. Free skating has no required elements and has a length limitation of 4 minutes for women and 4 $\frac{1}{2}$ minutes for men. In free skating, the skaters select their own music and theme, and choreograph many difficult spins, jumps, footwork, and interpretive moves to best display their technical and artistic skills. As in the short program, scores are given for technical merit and for presentation.

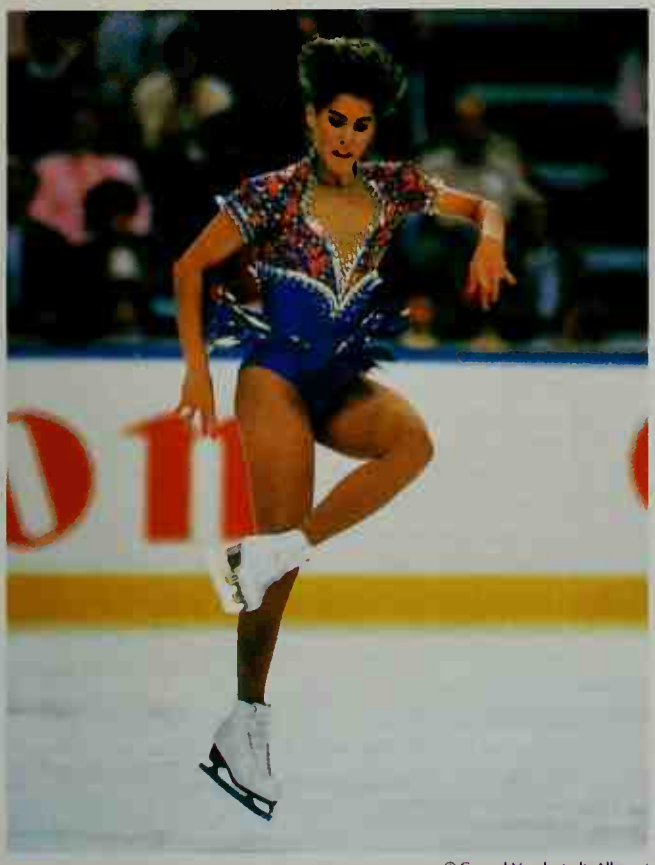
Pair skating. In pair skating events, the couples try to express a feeling of harmony and teamwork through their skating. Pair skating involves certain moves specifically designed for a man and woman skating together. The most spectacular moves are *lifts,* in which the man picks up his partner and carries her above his head. Pair skaters perform most moves in unison. The partners may separate at times and perform individually, but the two must maintain the impression that they are performing as a true team. Like single skating, competition in pair skating consists of the short program and the free skating program.

The short program counts one-third of each pair's score. The program calls for eight moves that all the pairs must perform. However, each couple may arrange the moves and the steps that link them in any order and pattern. The pairs select their own music. The program must be completed within 2 minutes 40 seconds.

The judges score each couple on required elements and presentation. They base the artistic impression score on such factors as creativity, how well the pair expressed a sense of unity, and how smoothly their steps linked the various moves.

The free skating program makes up two-thirds of each pair's score. The couples select their own moves and their own music. Each pair's program may last up to 4 $\frac{1}{2}$ minutes. As in the short program, the judges give scores for technical merit and presentation. In scoring presentation, they rate each pair's program on composition and style. They also consider how well the couple express a feeling of "togetherness."

Ice dancing combines skating with ballroom dancing. It differs from pair skating in several ways. In ice dancing, for example, the couple may separate only briefly to change direction or position. No high lifts are permitted. Each partner must have one skate on the ice at all times except during brief lifts and spins when the woman may have both skates off the ice. The couples perform many moves developed specifically for ice dancing. These moves closely resemble steps used in ballroom dancing.



© Gerard Vandystadt, Allsport

Figure skating requires grace and athletic ability. In the free skating portion of a competition, skaters create a program of spins, leaps, and other movements, performed to music.

Ice dancing competition consists of three parts. They are, in the order performed: (1) compulsory dances, (2) the original dance, and (3) free dancing.

Compulsory dances count 20 percent of the score in ice dancing. All the couples perform two particular dances to the same music. A typical group of compulsory ice dances would be based on the waltz, the rumba, and the tango. Skaters must perform the dances according to official diagrams. The judges award a separate score for each compulsory dance performance.

The original dance makes up 30 percent of a couple's score. The partners select their own steps and music, but all couples must choose music that follows a certain dance rhythm announced in advance. The dance must be composed of repetitive sequences consisting of either one half circuit or one complete circuit of the ice surface. It must be skated two times around the surface.

Couples receive scores for technical merit and presentation. Presentation includes how well a couple expressed the music's theme and tempo.

The free dance accounts for 50 percent of the score. The couples select their own combinations of dance movements but may not repeat combinations. They also choose their own music, which must have variations in tempo and be suitable for dancing. Each couple must complete their program within four minutes.

The judges grade each couple's program on technical merit and artistic impression. Artistic impression involves the composition of the dance and how well the partners interpreted the music and its theme.

Synchronized skating stresses formations and maneuvers performed in unison by teams of skaters. Unlike other types of figure skating, synchronized skating permits the use of vocal music. The teams are judged on the composition, presentation, and originality of their routines, as well as their footwork and speed. A senior program can last up to 4 $\frac{1}{2}$ minutes.

Speed skating

Speed skating consists of races over various distances on oval, ice-covered tracks. Some skaters reach a speed of 35 miles (56 kilometers) per hour.

The blade and boot of speed skates are so designed that skaters can start quickly and maintain a high rate of speed throughout a race. The blade is flat, straight, and thin. It measures 12 to 18 inches (30 to 45 centimeters) long and only about $\frac{1}{32}$ inch (0.8 millimeter) wide. Steel tubing reinforces the blade. The boots are lightweight and have a low-cut top.

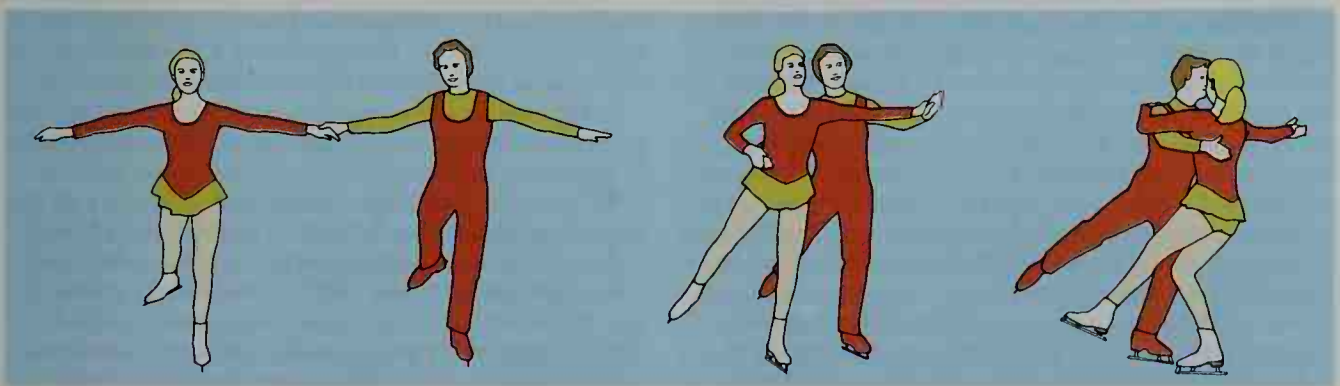
In the mid-1990's, many speed skaters began using a "clapskate," in which the blade is hinged to the boot's toe. The clapskate design permits the skater to get maximum propulsion by keeping the blade continuously in contact with the ice throughout each stride. A traditional speed skate leaves the ice as part of the skating motion. Skaters using the clapskate set many speed records, and the design promised to revolutionize the sport.

Speed skaters wear gloves or mittens and a one- or two-piece uniform with long sleeves. The uniform is

Ice dancing positions

Skaters use a number of basic positions in performing an ice dance. They include the hand-in-hand position, *left;* the Kilian position, *center;* and the closed, or waltz, position, *right.*

WORLD BOOK illustrations by David Cunningham



made of lightweight synthetic fabric designed to offer little wind resistance.

Good speed skating technique depends on three factors: (1) balance, (2) rhythm, and (3) drive. These factors enable a skater to produce smooth, powerful strokes. Strength and speed are also important.

A speed skater's center of balance is in the hip over the center of the forward skate that is pushing. As the legs move back and forth, the center of balance shifts from the outside of the blade to the center of the blade and onto the returning skate. Skaters keep the body relaxed and flexible. They lean forward from the waist with the back straight. They keep the head up and the eyes looking straight ahead.

A smooth, flowing motion produces the proper skating rhythm. The rhythm's most obvious part is the arm swing. Skaters swing one arm forward across the chest and the other to the rear. The forward arm is always opposite the forward leg. The swing keeps the skater's balance steady and helps raise the forward stroke's power.

The drive is the push from the legs on each stroke. Speed skaters use the blade's entire surface to push forward. They try to bend their knees as much as possible to increase the stroke's length. The longer the stroke, the more powerful will be the forward push. Skaters swing one arm forward across the chest and the other arm to the rear when competing in 500- and 1,000-meter sprint races. The forward arm is always opposite the forward leg. The arm swing keeps the skater's balance steady and helps increase the power of the forward stroke.

In races up to 1,000 meters long, skaters swing their arms on each stroke. In races 1,500 meters long, some skaters save energy and wind resistance by swinging one arm and keeping the other one behind. In races 1,500 meters and longer, most save energy by clasping both hands behind their back as they skate on the oval track's straight parts. They use the right arm swing as a counterbalance only while skating around turns.

There are three types of speed skating: (1) long-track, or Olympic-style, skating, (2) pack skating, and (3) short-track skating. Men and women compete separately.

Long-track skating is the most recognizable and popular type of racing in international competition. Two skaters race each other on a two-lane track 400 meters (437 yards) around. Each lane should be about 5 meters (16 feet) wide. A band of snow, colored markers, or a painted line beneath the ice divides the lanes.

Most men's international competitions are 500, 1,000, 1,500, 5,000, and 10,000 meters long. Women's races cover 500, 1,000, 1,500, 3,000, and 5,000 meters.

Skaters start a race either side-by-side or staggered, depending on the distance of the race. The skater starting in the inner lane wears a white armband. The skater starting in the outer lane wears a red armband. When the starter orders "go to the start," both skaters move to the area between the pre-starting line and the starting line. The lines are about 30 inches (75 centimeters) apart. At the word "ready," both skaters assume their starting positions, holding them until the starter fires a gun. Each skater is allowed one warning for a false start. A second false start means disqualification.

Skaters compete in several heats called *pairs*. Winning the pairs does not necessarily mean winning the event. Skaters race against the clock. Their times are converted into points, and the skater with the lowest point total wins the event

Pairs and lane assignments are determined by a drawing before the event. Names are drawn two at a time from a pool of *seeded* (ranked) skaters, forming a pair. The fastest skaters receive the highest seeds. Each pair skates in the order in which it was drawn. Skaters prefer to skate in the fastest pair possible to improve their chances for a fast time.

During the race, the speed skaters must change lanes each time they reach the *crossing straight*. This is the straight-away area on the track opposite the starting line. The only times skaters do not change lanes are on the first laps of 1,000-meter and 1,500-meter races run on a 400-meter track. Competitors change lanes so that each skater races the same distance because the inside lane covers a shorter distance than the outside lane.

A skater has completed the distance when he or she has touched or reached the finish line with the tip of the skate as recorded by an electronic eye beam. The winner for each race is the skater with the lowest time, measured to $\frac{1}{100}$th of a second, after all the skaters have raced. If two skaters tie, they are judged as tied. No tiebreakers are allowed.

Skaters who fall during a race are allowed to get up and continue. For distances less than 5,000 meters or 10,000 meters, however, it is generally impossible to make up lost time.

In most meets, skaters enter all the races. In sprint championships, they skate 500 meters and 1,000 meters on the first day, and repeat the same races on the second day. After all the competitors have raced, the one with the fastest overall time in the four events wins. The *samlog* scoring system is converted into points. Each second in the 500 equals 1 point, and each second in the 1,000 equals one-half of a point.

In the all-around championships, starters race short and long distances. Men skate 500, 1,500, 5,000, and 10,000 meters. Women skate 500, 1,500, 3,000, and 5,000 meters. The samlog scoring system for the longer distances gives one-third of a point for each second for 1,500 meters, one-sixth of a point for 3,000 meters, one-tenth of a point for 5,000 meters, and one-twentieth of a point for 10,000 meters. The skater with the lowest point score wins. In world all-around championships, only the top 16 finishers after three races qualify for the fourth and longest race.

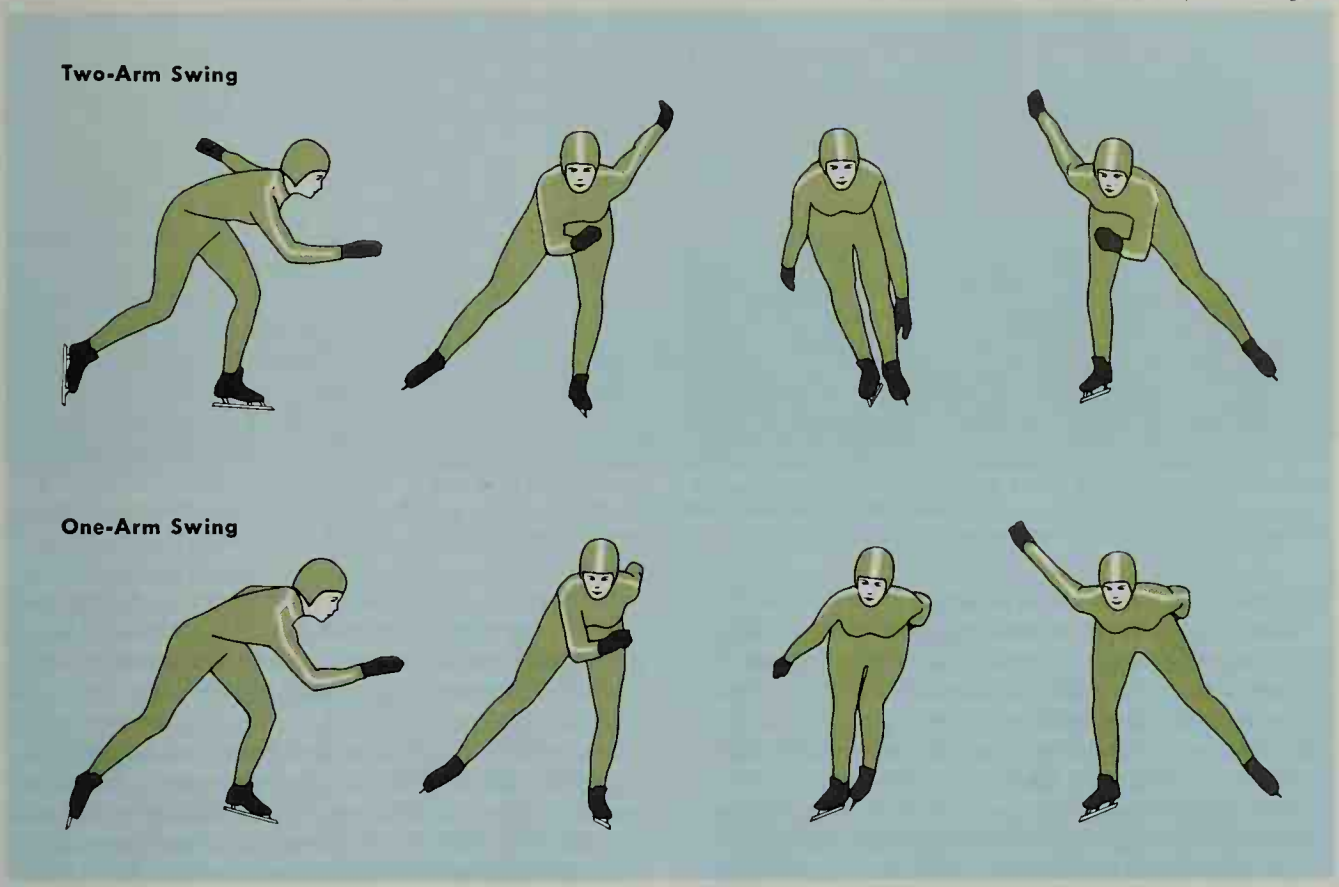
Pack skating has a number of competitors race at one time in a series of elimination races. Qualifiers then advance to final races.

Pack-skating meets are held on both indoor and outdoor tracks. Most outdoor tracks measure 400 meters around. Some indoor facilities house 400-meter ovals. Skaters also use a hockey rink for indoor competition.

In organized meets, men and women and boys and girls compete separately in five age classes. These classes are senior (age 18 and older); intermediate (ages 16 and 17); junior (ages 14 and 15); juvenile (ages 12 and 13); and midget (ages 10 and 11). The midget class sometimes includes three additional groups. The pony class is for skaters 8 or 9 years old. The peewee class is for 6- and 7-year-olds. The tiny tot class is for skaters 5 years old or younger. The senior class sometimes includes an additional group called the master division for skaters

Speed skating technique A speed skater leans forward at the waist, keeping the knees bent, the head up, and the eyes looking ahead. For a more powerful stroke, the skater uses an arm swing. In races up to 1,500 meters, the skater swings both arms. In longer races, the skater saves energy by swinging only one arm.

WORLD BOOK illustrations by David Cunningham



40 years old and older. Skaters may compete in older age classes but not in a younger one, except in the master division.

The length of the races in a pack-skating meet depends on the age class. The youngest skaters take part in the shortest races. For example, boys and girls in the midget class compete in races up to 600 meters long. Senior men compete in races up to 3,000 meters long. Each contestant in an age group must enter all the races. The number of races depends on the divisions and the type of competition.

At a meet, the skaters in each class first compete in a series of qualifying races called *heats*. From 6 to 10 skaters race at one time in a heat. In most meets, the skaters who finish first and second—and sometimes third—in each heat qualify for the next heat. The number of heats depends on how many skaters entered the event. In most meets, each final race has a maximum of six skaters.

The first four skaters to finish in each final race receive points. The winner of each race gets 5 points; the second-place skater, 3 points; the third-place skater, 2 points; and the fourth-place skater, 1 point. The skater with the most points is the class champion.

Short-track skating consists of two types of races: (1) individual races and (2) relay races. Men and women compete separately. This kind of racing is called *short track* because the races are held on an oval track 111 meters (364 feet) around, the size of a hockey rink used in international competition. The track must be at least 4.75 meters (15 $\frac{1}{2}$ feet) wide on the straightaways and at least 4 meters (13 feet) wide on the turns. It has no lanes.

Competitors normally skate in a series of heats or elimination rounds for the individual events. Heats include up to six skaters, with the top two finishers from each heat advancing to the next round.

Each skater is allowed one false start and is disqualified after the second. The start is crucial to the skater, especially in the shorter races, because the start is not staggered and a skater can move to the inside immediately. During the race, skaters must skate outside the rubber or plastic blocks that mark the shape of the track. However, a finger can skim the surface of the ice inside the blocks as long as the skater rounds the blocks.

Skaters must pass cleanly and without body contact. Passing is tricky. Skaters take advantage of key areas to pass. If the lead skater strays too far from track markers, an alert competitor can pass him or her on the inside. If the track is skated tightly by the pack, passing must be done on the outside.

Passing rules are strict. One infraction will disqualify a skater. The lead skater has the right of way, and the passing skater must assume responsibility for avoiding body contact. A skater can be disqualified for intentionally pushing, obstructing, or colliding with another racer, or for improperly crossing the course. A bell warns skaters when they are one lap from the finish of the race.

Individual races. In international championship meets, individual skaters compete in two short events (500 and 1,000 meters), a middle distance race (1,500 me-

W. Lee, St. Paul Winter Carnival Assn.

Pack skating is a type of speed skating in which several skaters race at one time in elimination races called *heats*. Qualifiers from the heats compete in final races to decide the champion.

ters), and a long race (3,000 meters).

Skaters must qualify in heats to compete in the final race. No more than four skaters can race at one time in the short races. No more than six can race in the 1,500-meter race at one time. No more than eight can race in the 3,000-meter race at one time. The skater who finishes first in the final wins the event.

Relay races involve four teams, each with four members. Men race in a 5,000-meter relay, and women in a 3,000-meter relay. One member from each team skates until replaced by a teammate. A teammate may replace a skater anytime except during the final two laps. Skaters may not begin to race until they touch, or are touched by, the teammate they replace. The team of the first skater to reach the finish line wins the race.

History

The earliest evidence of ice skating was found among Roman ruins in London and dates back to 50 B.C. Excavations uncovered leather soles and blades made of polished animal bones. About A.D. 1100, people in Scandinavia wore skates made of deer or elk bones, which were strapped to their boots with leather. These early skates were used for transportation. Recreational ice skating may have begun during the 1100's in Britain.

Iron blades were first used in the Netherlands about 1250. Steel blades on wooden soles apparently were first used about 1400. These skates were lighter than iron skates and made skating easier.

In 1850, E. W. Bushnell of Philadelphia produced the first all-steel skates. These skates were light and strong, and kept their sharp edges longer than iron skates. All-steel skates greatly increased the popularity of skating. Skating clubs opened across the country. About 1870, a young American ballet dancer named Jackson Haines became the first person to blend creative dance movements with ice skating. He is credited with introducing modern figure skating into Europe.

In 1892, the International Skating Union (I.S.U.) was founded. That year, the first international speed skating and figure skating competitions were held in Vienna, Austria. Figure skating was included in the 1908 Olympic Games, and speed skating became an Olympic event in 1924. Only men competed in Olympic speed skating until 1960, when women's competition began. Ice dancing became an Olympic event in 1976. Men's and women's short-track skating was added for the 1992 Games.

The first figure skater to become internationally famous was Sonja Henie of Norway. Henie was the women's Olympic figure skating champion in 1928, 1932, and 1936. Henie then appeared in several American movies that featured her skating. Other Olympic women's champions who became professional skating stars included Barbara Ann Scott of Canada, Peggy Fleming and Dorothy Hamill of the United States, and Katarina Witt of East Germany.

Dick Button of the United States was the leading men's figure skater of the mid-1900's, winning the Olympic championship in 1948 and 1952. Other men's Olympic and professional skating stars included John Curry and Robin Cousins of the United Kingdom, Toller Cranston of Canada, and Scott Hamilton of the United States. In the 1980 Olympics, Eric Heiden of the United States became the first athlete to win all five of the speed skating races. He set a record in each speed skating race. Bonnie Blair of the United States won five speed skating gold medals in the Olympics from 1988 to 1994. The star of the men's speed skating competition at the 1994 Olympics was Johann Olav Koss. He won three races, all in record time. The Netherlands dominated speed skating in the 1998 and 2002 Olympics, winning 5 of the 10 events in men's and women's speed skating in 1998 and 6 of the 10 in 2002.

Nicholas A. Paulenich and Kristin Matta

Related articles in *World Book* include:

Blair, Bonnie
Hockey
Olympic Games (table: Winter Olympic Games)
Ringette
Safety (In winter sports)
Scott, Barbara Ann

Outline

I. Skating safety
II. Figure skating
A. Singles skating
B. Pair skating
C. Ice dancing
D. Synchronized skating
III. Speed skating
A. Long-track skating
B. Pack skating
C. Short-track skating
IV. History

Questions

Who was Jackson Haines?
What is the object of synchronized skating?
How are winners determined in speed skating meets?
How do figure skates differ from speed skates?
What is the International Skating Union?
What is pack skating?
What is free skating in singles skating? In pair skating?
What are the three types of speed skating?
Who was Eric Heiden?
How does ice dancing differ from pair skating?
What safety procedures should a person follow in rescuing a skater who has fallen through the ice?

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Bezic, Sandra, and Hayes, David. *The Passion to Skate: An Intimate View of Figure Skating.* Turner Pub. Inc., 1996.

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James R Holland

Two huge icebergs dwarf a U.S. Coast Guard ice patrol ship. Such ships warn other vessels of the location and movement of icebergs. This information has saved many lives and ships.

Iceberg. Huge masses of ice may break off the lower end of a glacier and fall into the sea. These masses are called *icebergs,* and they are made of frozen fresh water. Fog and icebergs are two of the greatest natural dangers to ships.

Explorers have written vivid descriptions of the color and beauty of icebergs, and compared them to towers, spires, pyramids, cathedrals, and palaces. Large icebergs weigh more than 1 million short tons (910,000 metric tons), and some are many miles or kilometers long. The biggest ones tower as much as 400 feet (120 meters) above the surface of the ocean. But this is only a small part of the whole iceberg. Only one-seventh to one-tenth of the iceberg's total mass is above water.

The white color of icebergs is caused by tiny, closely spaced gas cavities throughout the ice. When the sun is shining, streams of water form on the slopes of icebergs and drop over their edges in waterfalls. Icebergs often carry away large boulders and quantities of gravel from their glaciers. These are carried for long distances and finally dumped in the sea when the iceberg melts.

North Atlantic icebergs come from the island of Greenland. A huge ice sheet covers nearly all of Greenland. It has an area of about 708,000 square miles (1,834,000 square kilometers) and an average thickness of 5,000 feet (1,500 meters). Long tongues of ice extend from the edge of this ice sheet into the sea. Cracks in the ice, and the action of rough sea waves, cause the icebergs to break off from the ice tongues. Noises like great explosions and rolling thunder accompany the beginning of an iceberg as it cracks loose. If the iceberg drops into an enclosed bay, it may cause huge waves.

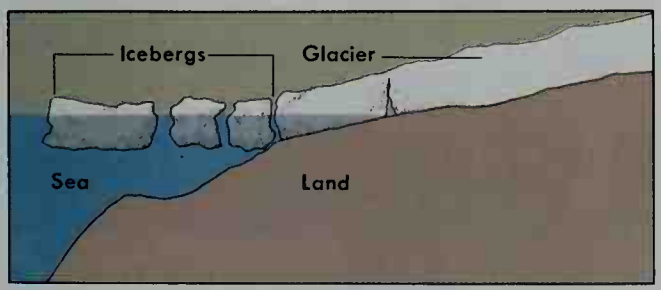
Most of the icebergs in the North Atlantic drift across Baffin Bay and Davis Strait to the coast of Labrador. Some of them are carried by the wind and the Labrador Current through the Newfoundland Banks into the Atlantic Ocean. In this region of the ocean, the icebergs melt rapidly because of the sunshine and warm ocean water. Parts of the icebergs may break off to form *bergy bits,* which are the size of an average house, or smaller pieces called *growlers.* Growlers are named for the noise they make as they float in the waves. Icebergs disappear about 400 miles (640 kilometers) south of Newfoundland.

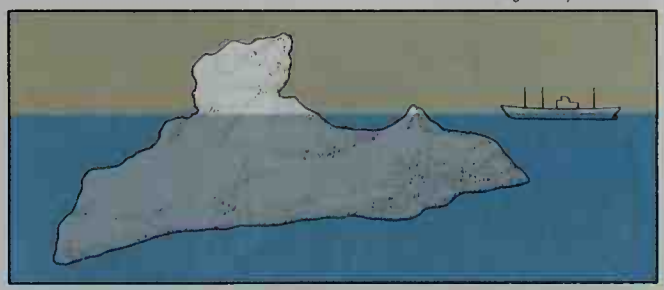
The greatest numbers of icebergs reach the routes of transatlantic liners in April, May, and June. That is why ships crossing the Atlantic follow a more southerly course during these months.

How icebergs form and melt

Icebergs form where chunks of ice break away from a glacier as it flows into the sea, *below left.* The sun and wind melt the top of an iceberg. The bottom, which is under water, melts much more slowly. As the top melts away, leaving the bottom hidden beneath the surface, the iceberg becomes extremely dangerous to ships, *below right.*

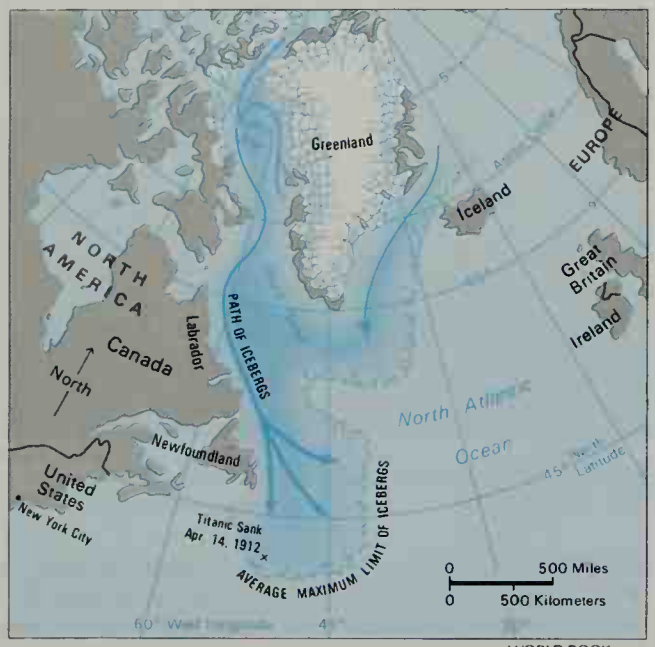
WORLD BOOK diagrams by Marion Pahl





The path of North Atlantic icebergs

Icebergs break off from the glaciers of Greenland and float southward into the North Atlantic Ocean. Ships and airplanes report the position of icebergs to the International Ice Patrol.



WORLD BOOK map

Antarctic icebergs. Many icebergs drift out to sea from the great Antarctic ice sheets. Some of these icebergs are many times larger than those found in the North Atlantic. The largest one ever seen in the Antarctic region had a length of about 200 miles (320 kilometers) at its longest point and a width of about 60 miles (97 kilometers) at its widest point. It covered about 5,000 square miles (13,000 square kilometers). Icebergs that are 10 miles (16 kilometers) long are common in the Antarctic. In contrast, the largest iceberg measured in the North Atlantic was 4 miles (6.4 kilometers) long.

Ice patrols. Icebergs can be extremely dangerous to ships. One of the greatest sea disasters in history was the sinking of the *Titanic* during the night of April 14 and 15, 1912. The *Titanic* was the largest ship afloat then, and was on its first trip from England to New York. The ship struck an iceberg, and about 1,500 persons died.

The wreck of the *Titanic* led to the establishment of an International Ice Patrol along the North Atlantic ship lanes. Since 1914, the patrol has been maintained through a sharing of its expenses by the principal shipping nations of the world. The United States Coast Guard does the actual patrolling. The patrol reports the position of icebergs and estimates their probable courses. Planes, ships, and satellites are used in patrolling. See **Coast Guard, United States.**

There is little human beings can do to control icebergs. It is difficult to destroy an iceberg by blasting, or to steer it into a different course which would take it out of an ocean shipping lane. It is even difficult to approach an iceberg, because the submerged parts may tear open a ship's bottom. James E. Overland

See also **Glacier.**

Iceboating, also called *ice yachting,* is a popular winter sport in northern regions of the United States and of European countries. Iceboats are small, speedy craft that resemble sailboats. They perform best in strong, steady winds on large areas of smooth ice. An iceboat can travel up to 100 miles (160 kilometers) per hour.

Iceboats. An iceboat has a long hull similar to that of an early airplane. Most have frames made of spruce or other strong, light wood. Plywood covers the frame. Some boats are made of aluminum or fiberglass. Most measure between 16 and 22 feet (5 and 7 meters) long.

The cockpit of an iceboat holds one or two persons in a sitting or semireclining position. Under the hull, a steel runner is attached to each end of a crosspiece called a *runner plank.* A third runner is used for steering. It is fastened to the front of the hull or on a springboard projecting forward of the bow. This runner is connected with steel cables to a handle called the *tiller,* a wheel, or foot pedals in the cockpit.

A mast of aluminum or spruce stands in front of the cockpit. Steel cables fasten the mast to the hull and the runner plank. Iceboat sails are made of heavy synthetic cloth. From four to eight stiff narrow strips of wood called *battens* control the sail's shape at high speed. Older stern-steering iceboats had about 350 square feet (33 square meters) of sail. Modern boats need only 75 square feet (7 square meters) or less and perform better.

Sailing an iceboat. An iceboat is started by pushing it across the wind with the sail let out. The iceboater

Focus on Sports

Iceboating is a popular winter sport in many northern countries. The iceboat is a light, sturdy craft that resembles a sailboat with runners. Iceboats can skim along the ice at speeds up to 100 miles (160 kilometers) per hour.

then jumps aboard and pulls in the sail to make the boat pick up speed. An iceboat travels fastest when moving about 15° in the direction of the crosswind.

Iceboaters wear spiked shoes for firm footing to help them push the boat when starting it. Warm clothing is essential for comfort and to prevent frostbite. Goggles shield the eyes against snow and flying ice, and a crash helmet protects the head in case of an accident.

Iceboat races are held on a course marked by two buoys placed about 1 mile (1.6 kilometers) apart in line with the wind. The boats begin from a standstill at the downwind end of the course. They must pass both buoys counterclockwise, usually for three laps. The National Iceboat Authority sets the rules for races held in the United States. Races are held for various classes of iceboats. Boats of all classes sometimes compete against one another in *open* races.

History. The first iceboats probably were used in the Netherlands during the 1600's. They were sailboats fitted with runners and used as cargo boats on canals. In the late 1700's, Dutch settlers in the Hudson River area of New York built stern-steering sporting iceboats that could hold six or eight people. These boats traveled as fast as 60 miles (95 kilometers) per hour.

In the early 1930's, a small, lightweight front-steering iceboat, called a *skeeter,* was introduced. Improved versions of that model attracted many people to iceboating because of the skeeter's high speed, low cost, small size, and portability. The most popular racing iceboat is the *DN.* It is even smaller than the skeeter and easier to transport.

Today, iceboating is most popular in the United States, especially on the East Coast and in the Great Lakes region. The nation has about 8,000 iceboaters, and about 2,000 more enjoy the sport in the countries of northern Europe.

Critically reviewed by the International DN Ice Yacht Racing Association

Icebox. See Refrigeration.

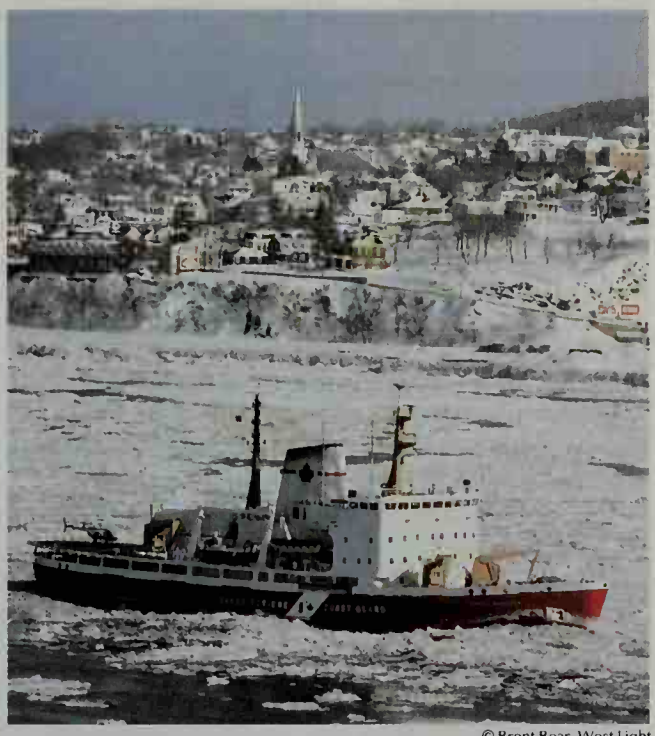
Icebreaker is a ship designed to travel through ice-covered waters. Icebreakers use their extraordinary power to push their bows up on top of the ice until the weight of the ship causes the ice to collapse. The ship must have a specially designed bow and a strengthened hull. The largest icebreakers are designed to break ice that is 8 feet (2.4 meters) thick while maintaining a slow but steady speed. By backing up and then ramming the ice, some icebreakers can break through ice that is more than 23 feet (7 meters) thick.

In the Arctic and Antarctic, *polar icebreakers* are used to rescue ships trapped in ice, to conduct scientific research, and to escort supply ships through ice-covered waters. *Subarctic icebreakers* are used in winter to break up the relatively thin ice that covers seas, lakes, and rivers outside polar regions. Countries that operate polar icebreakers include Argentina, Canada, Germany, Japan, Russia, Sweden, and the United States.

Critically reviewed by the United States Coast Guard

International DN Ice Yacht Racing Association

Boats in an iceboat race start slowly, but quickly reach speeds up to 3 $\frac{1}{2}$ times faster than that of the wind.



© Brent Bear, West Light

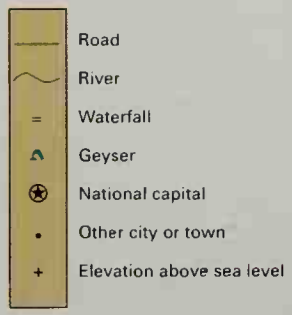
A Canadian Coast Guard icebreaker smashes through the ice on the St. Lawrence River in Quebec. The ship rides up on the ice until its weight causes the ice to break.

Icecap is a mass of ice and snow covering an area of 19,200 square miles (50,000 square kilometers) or less. It consists of a central ice dome bordered by small glaciers that flow outward. Many icecaps blanket mountainous areas. Such icecaps include the Jostedal Glacier in southwestern Norway and the Vatnajökull Glacier in southeastern Iceland. Other icecaps occur on Arctic islands. Those include the Barnes and Penny icecaps on Baffin Island in Canada.

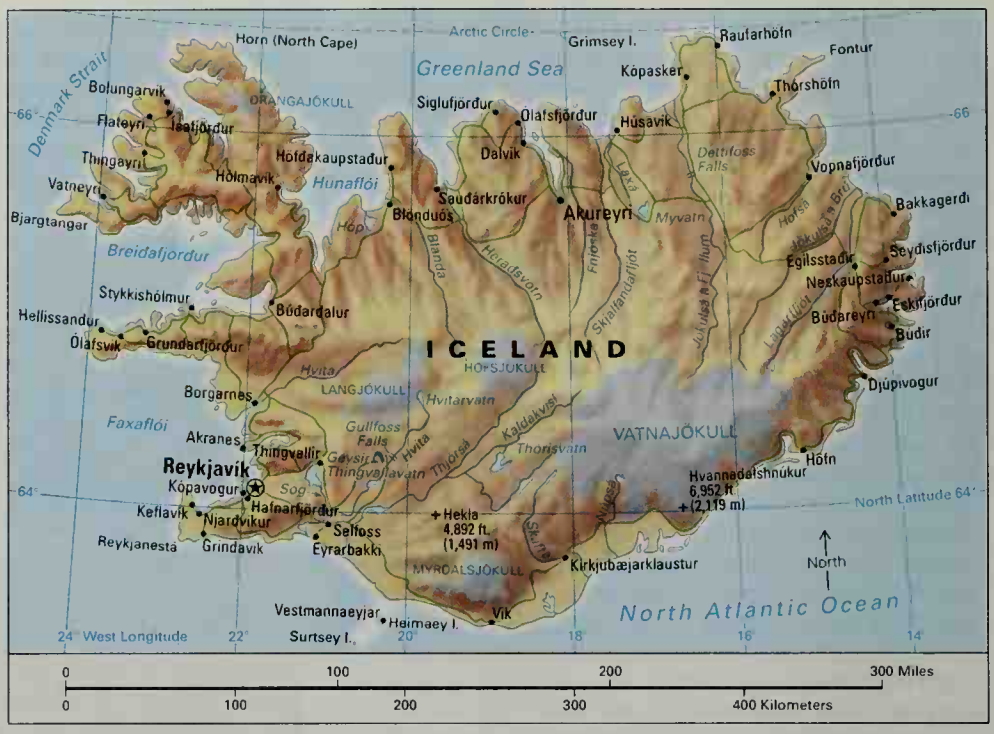
People sometimes use the term *icecap* to refer to massive glaciers that cover Earth's polar regions. However, most scientists call such glaciers *ice sheets.* Nearly all of Antarctica is covered by two thick ice sheets, one on either side of the Transantarctic Mountains. Those sheets have an average thickness of about 7,100 feet (2,200 meters). An ice sheet also covers most of Greenland. Joseph M. Moran

See also Glacier.

Iceland



WORLD BOOK maps



Iceland is an island country that lies just below the Arctic Circle in the Arctic and North Atlantic oceans. It is about 200 miles (320 kilometers) east of Greenland and about 650 miles (1,050 kilometers) west of Norway.

Iceland is sometimes called the Land of Ice and Fire because large glaciers lie next to steaming hot springs, geysers, and volcanoes. The country was named Iceland by an early explorer who was upset by seeing the coastal waters choked with ice after an unusually cold and long winter. But Iceland is not as cold as most places so far north. The Gulf Stream ocean current warms most of Iceland's coast. Iceland is also a land of *midnight sun*. It is light almost 24 hours a day in June and dark for a similar period in December.

Most Icelanders live in coastal towns. Many of them make their living from the sea, either by fishing or by working in fish processing plants. Almost all the country's exports are fish or fish products.

People from Norway and from Viking colonies in Britain and Ireland settled Iceland beginning about A.D. 870. Norway gained control of the island in 1262. After 1380, Denmark ruled Iceland. In the late 1800's, the Icelandic government regained control over internal affairs. In 1918, Iceland became a self-governing kingdom united with Denmark. The country gained full independence in 1944. Its official name in Icelandic is Lýdveldid Ísland (Republic of Iceland). Reykjavík is the country's capital and largest city.

Government

National government. Iceland is a republic. The people elect a president, who serves for four years. The president is the official head of state but has little power. The prime minister and the Cabinet propose and carry out government policies. They are appointed by the president with the approval of the Althing (parliament).

The Althing passes laws for the country. The people elect 54 of the 63 Althing members. The other 9 seats are divided among the political parties so that the percentage of representatives each party has in the Althing is about the same as the percentage of votes each party received in the elections.

All Althing members serve four-year terms. The Althing divides itself into a 21-member upper chamber and a 42-member lower chamber.

Iceland has several political parties. They include the Independence Party, the People's Alliance, the People's Movement (also called the Awakening of the Nation), the Progressive Party, the Social Democratic Party, and the Women's Alliance.

Local government. A magistrate appointed by the national government and representatives from the rural communities govern each county. Councils, elected to four-year terms, govern the towns. Local governments handle welfare, education, health, roads, and law en-

Facts in brief

Capital: Reykjavík.
Official language: Icelandic.
Official name: Republic of Iceland.
Area: 39,769 mi² (103,000 km²). *Greatest distances*—east-west, 300 mi (483 km); north-south, 190 mi (306 km). *Coastline*—1,243 mi (2,000 km).
Elevation: *Highest*—Hvannadalshnúkur, 6,952 ft (2,119 m) above sea level. *Lowest*—sea level.
Population: *Estimated 2002 population*—286,000; density, 7 persons per mi² (3 persons per km²); distribution, 92 percent urban, 8 percent rural. *1970 census*—204,930.
Chief products: *Agriculture*—cattle, hay, sheep. *Fishing*—capelin, cod, haddock, herring. *Manufacturing*—aluminum, cement, clothing, electrical equipment, fertilizer, food products, printed materials.
Flag: A red cross appears inside a white cross on a blue field. See Flag (picture: Flags of Europe).
Money: *Basic unit*—krona. One hundred aurar equal one krona.

John Elk III

A group of hikers cross Iceland's rugged landscape. Glaciers cover part of the land in Iceland. Other natural wonders include geysers, waterfalls, hot springs, and active volcanoes.

forcement programs. Some local governments also own fishing boats or operate businesses, such as fish processing plants.

People

Iceland was settled more than 1,100 years ago by people from Norway and from Viking colonies in Britain and Ireland. Some of these settlers had married Celtic people, and some had Celtic slaves. Today's Icelanders resemble the people of Ireland, Scotland, and Scandinavia (the countries of Denmark, Norway, and Sweden).

Nearly all Icelanders live near the coast. About half of the people live in or near Reykjavík, and the rest live in villages and small towns around the island.

Icelanders speak a Scandinavian language called *Icelandic*. The language is so much like Old Norse, the original language of their ancestors, that most people today are able to read tales and poems written in the 1100's and 1200's. Most Icelanders also speak two or more foreign languages, usually English, German, or a Scandinavian language.

Icelanders do not have family names. They have a first name, such as Ásgeir or Inga, and a second name that combines the father's first name and *-son* for a male or *-dóttir* for a female. Thus, if Ásgeir and Inga's father were Jón Stefánsson, their names would be Ásgeir Jónsson and Inga Jónsdóttir. Because there are no family names, all Icelanders are properly addressed by their first names. Also because there are no family names, a woman does not change her name with marriage. So many Icelanders have the same name that telephone directories list each person's occupation in addition to his or her name and address.

Way of life

The cost of living in Iceland is high because so much of what Icelanders buy—from automobiles to paper—is imported. Households often require two or more incomes. Most women work outside the home, and some men hold more than one job. The government provides day care for young children of working parents.

Before marrying, many young couples live together in the home of either the man's parents or the woman's parents. They may live there for years while working and saving their money for an apartment or a house. During this time, they may have one or more children. More than 60 percent of all first-born children in Iceland are born before their parents are married. Most couples marry only after they are economically self-sufficient.

Housing. Icelanders spend a large portion of their incomes on their houses, equipping them with imported television sets, refrigerators, electric stoves, and other appliances. Houses were once built of turf and stone in the country and wood in the cities. But most houses are now built with reinforced concrete, which is not easily damaged by earthquakes or by the high winds that sweep the coasts. Many people paint the outside of their house a pastel color. Natural hot water piped from hot springs is used throughout Iceland for hot tap water.

© Mats Wibe Lund, Icelandic Photo & Press Service

National Day festivities include folk dancing in traditional costume. National Day is celebrated each June 17, the day Iceland officially gained its independence from Denmark in 1944.

It is also used to heat buildings and to heat greenhouses where fruits, vegetables, and flowers are grown.

Food. Icelanders eat more lamb and fish than do people in most other countries. Even hot dogs are made of lamb rather than beef or pork. Special Icelandic foods include blood sausages and boiled sheep's head. A traditional dessert is *skyr,* made from milk curds. Skyr is like thick sour cream, and it is usually served with sugar and cream.

Recreation. Icelanders like sports, especially swimming. People swim throughout the winter in indoor pools and in outdoor pools that are warmed by hot springs. Icelanders also like basketball, handball, skiing, soccer, and a kind of wrestling called *glíma.* Many people play chess and bridge. Iceland has several theaters and a symphony orchestra.

Religion. Most Icelanders belong to the state church, the Evangelical Lutheran Church. Some belong to the Lutheran Free Churches and a few belong to other Protestant churches or to the Roman Catholic Church. Iceland also has an official pagan church.

Education. The government requires children from 7 to 15 years of age to attend school, except those in sparsely populated areas. In rural areas, children ride buses to school or attend boarding schools. After six years of primary school and three years of general secondary school, children may attend grammar school for four years.

Iceland has two universities. The University of Reykjavík is located in the capital. The University of Akureyri is in Akureyri, a city on the northern coast of Iceland. The country has teacher training and commercial colleges, as well as schools that teach arts and crafts, farming, home economics, marine engineering, and nursing. Iceland also has a school of law, a medical school, a music conservatory, and a nautical school.

John Elk III

Fish processing, Iceland's most important industry, provides jobs for many of the nation's workers.

The land

A large plateau covers most of the island. But the land drops sharply to grassy lowlands along the coast.

The lowlands provide the only livable areas in Iceland. Grass grows there, and the people can raise sheep and some food crops. Part of the Gulf Stream flows around the southern and western coasts and parts of the northern coast, warming the lowlands and keeping the ports free of ice all year long. Summers are mild, and winters are cool. In Reykjavík, the average temperature is 52 °F (11 °C) in July and 30 °F (−1 °C) in January. The city gets about 30 inches (76 centimeters) of rain a year.

The inland plateau is a rugged, barren area about 2,500 feet (762 meters) above sea level. A *fault line* (line of breaks in the earth's rocky outer shell, along which rock has moved) runs across Iceland. It makes the plateau a land of violent natural wonders, including volcanoes, hot springs, steaming geysers, glaciers, and glistening lava fields. Earthquakes are fairly common.

More than 200 volcanoes have erupted in Iceland, spreading lava and rocks over the plateau. Some of the volcanoes are still active, including Hekla, a volcano that is well known for its large eruption in 1947 and 1948. There are also active volcanoes under the sea off the Icelandic coasts. One of them erupted in 1963 south of Iceland and formed a new island called Surtsey. In 1973, a volcano that had been dormant for more than 5,000 years erupted on the island of Heimaey, south of Iceland. It poured volcanic ash over the island's only town, Vestmannaeyjar, forcing evacuation of all the residents.

Iceland has more hot springs and sulfur steam areas than any other country. Some of the hot springs are geysers that spout streams of water into the air. In fact, the word *geyser* comes from the name of Iceland's most famous hot spring, *Geysir,* which spouts water about 195 feet (59 meters) into the air.

Glaciers cover one-eighth of the land. These huge sheets of ice are three-fourths of a mile (1.2 kilometers) thick in some places. The largest glacier, Vatnajökull, covers 3,140 square miles (8,133 square kilometers) and is as big as all the glaciers on the European continent combined. Glaciers have cut deeply into the bottoms of many *fiords* (long, narrow inlets of the sea) and have made good natural harbors at Akureyri and Ísafjördur. Ancient glaciers also dug holes in the land, and the countryside is dotted with small lakes. The largest lake is Thingvallavatn in the southwest.

Some glacial regions receive about 180 inches (457 centimeters) of rain each year. Water from the rain and melting glaciers forms rushing rivers and beautiful waterfalls. The longest river, Thjórsá, flows 150 miles (241 kilometers) through southern Iceland. Hydroelectric plants have been built on the swift-flowing Laxá and Sog rivers. The most beautiful waterfalls in Iceland are Gullfoss in the south and Dettifoss in the north.

Economy

Iceland has few natural resources, and only a small percentage of the land can be used for farming. However, Iceland's coastal waters are rich in fish. The country

depends heavily on its sales of fish and fish products for the money it needs to buy appliances, fruits and vegetables, heavy equipment, and raw materials from other countries. Iceland trades mainly with France, Germany, the United Kingdom, and the United States.

Fishing industry. About one-seventh of the working people catch fish for a living or are employed in fish processing plants. Fishing crews use large *trawlers* (fishing boats) to drag fish nets along the ocean bottom. On small motor boats and open boats, crews often use long-lines with hooks to catch fish. Some of the long-lines may be 10 miles (16 kilometers) long. The chief fish caught are capelin, cod, haddock, and herring.

Fish processing is Iceland's most important industry. Small processing plants stand along the coasts, and there are large freezing plants in Reykjavík and Siglufjördur. Most of the fish are dried, salted, or quick-frozen for sale to other countries. Some fresh fish are packed in ice and shipped to Germany and the United Kingdom.

Manufacturing. Iceland has a thriving publishing business. Other industries make aluminum, cement, clothing, electrical equipment, fertilizer, and food products. About a third of the industrial workers are women.

The Icelandic government has developed industries with aid from other countries. In 1968, an American firm completed a plant to remove *diatomite* (a mineral used in industrial filters) from the bottom of Lake Mývatn. A Swiss-built aluminum *smelter* (ore-melting furnace) began producing aluminum in the early 1970's.

Agriculture. About 5 percent of the people are farmers. Iceland has about 4,200 farms scattered over the lowlands. Most farmers raise sheep for wool, meat, and skins, and cattle for dairy products. They also raise many small Icelandic horses. The main crop is hay, used mainly to feed the livestock. Farmers can raise two or three crops of hay each year because of the heavy rainfall and the long hours of summer sunshine. Farmers also grow root crops, such as turnips and potatoes.

Since the 1930's, farmers have developed an industry that uses greenhouses to capture heat from hot springs. In the greenhouses, farmers can grow tomatoes, vegetables, flowers, grapes, and even bananas.

John Elk III

Reykjavík, the capital and largest city of Iceland, lies on the nation's southwestern coast. This picture shows a public square in the city's downtown area.

Transportation and communication. Iceland does not have any railroads. Its people travel mainly by bus, automobile, and airplane. Except for the streets in the cities, most of Iceland's roads have gravel surfaces.

Icelandair, the nation's airline, provides regular European and transatlantic service. There is an international airport at Keflavík, near Reykjavík. Also near Reykjavík is an airport that handles domestic flights. Iceland's chief ports are Akranes, Akureyri, Hafnarfjördur, Ísafjördur, Keflavík, Reykjavík, and Siglufjördur.

Most households in Iceland have a telephone, a television set, and at least one radio. The country communicates with the rest of the world by telegraphic cable and radio satellite.

History

Early days. Ingólfur Arnason, who fled from Norway, and his followers settled in Iceland about A.D. 870. Other settlers from Norway and from Viking colonies in Britain and Ireland helped increase the population of Iceland to about 25,000 in the next 60 years. In 930, the settlers of Iceland established the Althing, the world's first parliament. Among the early settlers was the Viking explorer Eric the Red. He lived in Iceland for several years before he sailed off to Greenland in about 982 and established the first colony there.

The 1100's and 1200's were Iceland's *golden age* of literature. In the early 1200's, Snorri Sturluson, a poet and historian, put into writing some of Iceland's greatest *sagas* (tales about Icelandic and Scandinavian heroes). He also completed his *Prose Edda,* a textbook for poets, which included stories about the gods and heroes of early Germanic tribes.

Civil wars broke out in the 1200's. To end the wars, the Althing agreed in 1262 to accept the king of Norway as ruler of Iceland. Norway united with Denmark in 1380, and Iceland came under Danish rule.

Great disasters struck Iceland between 1400 and 1850. The *Black Death* (a form of plague) killed about a third of the people on the island from 1402 to 1404. Much of Iceland's livestock, crops, and farmland was destroyed by lava when volcanoes erupted in the late 1700's. The people did not have enough to eat, and many starved to death in the period from 1783 to 1790.

Iceland often had to import food to feed its people. In the 1600's and 1700's, Denmark imposed harsh trade restrictions on Iceland. Danish traders bought fish from the Icelanders at low prices and sold them food at high prices. As a result, many people became very poor. During the Napoleonic Wars in the early 1800's, ships bringing food could not reach Iceland and many people suffered from hunger.

Life on the island improved later in the 1800's. The Althing, abolished in 1800, was reestablished in 1843. In 1874, Denmark gave Iceland a constitution and control of its finances. Iceland became a self-governing kingdom that was united with Denmark in 1918.

Independence. In World War II (1939-1945), German troops occupied Denmark. The Danes could not defend Iceland, so British troops landed in Iceland in 1940 to keep Germany from seizing the country. Later, United States troops replaced the British forces.

During World War II, Icelanders began demanding more control over their government. In 1944, 97 percent of Iceland's people voted to cut all political ties with Denmark. Iceland officially gained independence on June 17, 1944. Iceland joined the United Nations in 1946 and the North Atlantic Treaty Organization (NATO) in 1949. Iceland's only military force consists of a small coast guard. Under a NATO agreement, a small U.S. military force is stationed at an air base near Keflavík.

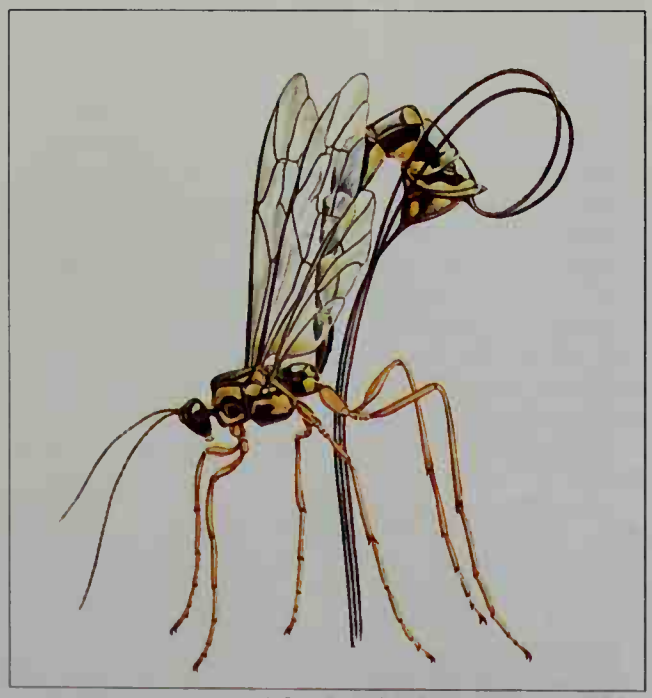
Between 1958 and 1972, Iceland gradually extended its coastal fishing limits and prohibited other countries from fishing in that zone. The United Kingdom objected to each of the extensions but eventually agreed to abide by them. In 1975, Iceland extended the limits to 200 nautical miles (370 kilometers). The dispute between Iceland and the United Kingdom flared up again. Iceland fired on some British fishing boats. In 1977, after discussions of the conflict by the World Court, the United Kingdom agreed not to fish within Iceland's 200-mile limits.

Recent developments. Iceland joined the European Free Trade Association (EFTA) in 1970. Some of the association's members left to join the European Community, which developed into the European Union (EU) in 1993. While EFTA reduces trade barriers between members, the EU seeks much broader cooperation among its members. Iceland—along with Liechtenstein, Norway, and Switzerland—remained in EFTA and declined to join the EU. Kirsten Wolf

Related articles in *World Book* include:

Ashkenazy, Vladimir	Geyser	Saga
Edda	Glacier	Snorri Sturluson
European Free Trade Association	Hekla	Volcano
	Reykjavík	

Ichneumon wasp, *ihk NOO muhn,* is an insect that lives as a parasite of other insects or spiders. The *larvae* (young) of most ichneumon wasps develop inside the immature stages of other insects. Some grow inside the bodies of spiders.



WORLD BOOK illustration by Oxford Illustrators Limited

A female ichneumon wasp has an egg-laying organ made up of three long threadlike strands. The wasp uses the organ to place its eggs inside spiders or the larvae of other insects.

Ichneumon wasps measure about $\frac{1}{8}$ inch to 2 inches (0.3 to 5 centimeters) long. In addition, the female has an egg-laying organ called an *ovipositor* that may be up to about $6\frac{1}{2}$ inches (16.5 centimeters) long. Three threadlike strands make up the ovipositor tube. These strands slide back and forth to move eggs down the tube. Some species of ichneumon wasps drill into trees with their ovipositors and release their eggs in tunnels inhabited by the larvae of beetles and other wasps.

Ichneumon wasps are important to agriculture because they feed on many insects that destroy plants. There are over 3,000 species of true ichneumon wasps in North America and nearly 2,000 species of braconid wasps, a closely related group. James E. Lloyd

Scientific classification. Ichneumon wasps are members of the order Hymenoptera. They form the family Ichneumonidae.

Ichthyology, *IHK thee AHL uh jee,* is the branch of zoology, or the science of animals, that deals with fishes. It includes the study of the development, structure, and habits of fishes, of the classification of fishes, of their geographical distribution, and of the relationships between fishes and their environment. Ichthyology includes aspects of their importance to people, such as fisheries and the conservation of food and game fishes. See also **Fish; Fishing industry; Fossil.** John D. McEachran

Ichthyornis. See **Bird** (The development of birds [The first known birds]).

Ickes, *IHK eez,* Harold Le Claire, *HAR uhld luh klahr* (1874-1952), served as United States secretary of the interior from 1933 to 1946. He became known for his sharp criticism of public officials. But he held the position of secretary of the interior longer than anyone else because he was honest and a clever administrator. Ickes was appointed by President Franklin D. Roosevelt. He was a defender of Roosevelt's New Deal economic recovery program during the Great Depression. From 1933 to 1939, he was director of the New Deal Public Works Administration. In the early 1940's, during World War II, he was administrator of the U.S. petroleum program.

Ickes was born on March 15, 1874, in Blair County, Pennsylvania. He graduated from the University of Chicago. Ickes worked as a lawyer and a newspaper columnist. He became active in politics in 1897. He was originally a Republican, but he joined the Progressive Party in 1912 and later became a Democrat. His huge and fascinating *Diary* is an important source for the history of his times. Alonzo L. Hamby

Icon, *EYE kahn,* is a religious painting considered sacred in the Eastern Orthodox Churches. Most icons are portraits of God, Jesus Christ, or saints. They are painted according to rules established by church authorities and are intended to convey the heavenly glory of the holy subjects portrayed. Thus, icons appear more stylized than realistic. They lack shadows, and figures may seem stiff and posed. Icons are displayed in homes and in churches, especially on the *iconostasis,* a screen that stands between the sanctuary and the congregation. Worshipers show devotion by praying before icons, kissing them, or lighting candles. Icons are often carried in religious processions. Robert S. Ellwood, Jr.

See also **Byzantine art; Eastern Orthodox Churches**

Egg tempera painting on wood attributed to the School of Novgorod; Tretyakov Gallery, Moscow

A Russian icon shows the face of Jesus Christ with a cross in the background. An unknown artist painted it in the 1100's.

(Church buildings); **Iconoclast**.

Iconoclast, *eye KAHN uh klast,* has come to mean a person who attacks long-established beliefs. The word *iconoclast* comes from two Greek words, *eikon,* or *image,* and *klastes,* or *breaker.* In the days of the early Christian church, people who opposed the *veneration* (reverence) of images were called iconoclasts. A long dispute had divided the church, especially in the East, about images of Jesus Christ and the saints in churches. Emperor Leo III in 726 issued an order that all images and paintings in churches should be covered or destroyed. This order divided the church into opposite groups. The iconoclasts favored removing the images, but many people, particularly monks and women, opposed the iconoclasts.

After the second Nicene Council met in 787, the Empress Irene of the Byzantine Empire permitted images to be venerated, as long as the veneration had a different quality from that owed to God (see **Nicene Councils**). Finally, in 843, the Eastern Church again permitted pictures but not complete statues or images. In the Roman Catholic Church, images are venerated as symbols of the people represented by them. Eugene TeSelle

Iconoscope, *eye KAHN uh skohp,* was one of the first devices capable of converting light images into electric signals that could be used to produce a television image. It was invented in 1923 by the Soviet-born physicist and electronics engineer Vladimir K. Zworykin. Today, the iconoscope has been replaced in television cameras by orthicon, saticon, and vidicon tubes, which are smaller and more sensitive to light.

An iconoscope includes an insulating plate inside a large vacuum tube. The insulating plate consists of a metal plate on one side and many bits of silver on the other. When light passes through a window in the vacuum tube and strikes the silver, the silver becomes electrically charged. The charge is greater where the light is bright than where the light is dim.

The vacuum tube also has an *electron gun.* This device directs a stream of electrons at the charged bits of silver. The electron beam removes the charge from the silver bits and produces an electric signal on the metal plate opposite them. Stronger electric signals are produced when the electron beam strikes bits of silver that have a greater charge. Eventually, various parts of a television set convert the electric signals from an iconoscope into a television picture. James E. Thompson

See also **Television** (Early development); **Zworykin, Vladimir K.**; **Image orthicon**.

ICU. See **Intensive care unit**.

Id. See **Freud, Sigmund**; **Psychoanalysis** (Psychoanalytic theory).

**`Id al-Adha,** *IHD uhl ahd HAH,* is one of the two major festivals in Islam. The other major festival is called `Id al-Fitr. `Id al-Adha falls on the 10th through the 13th days of Dhul-Hijjah, the last month of the Islamic calendar. The festival coincides with the completion of the *Hajj,* the pilgrimage Muslims make to the sacred city of Mecca. `Id al-Adha means Feast of the Sacrifice in Arabic.

On the first day of the festival, Muslims gather an hour after sunrise in open spaces or in mosques to perform a community festival prayer service, called *salat.* Muslims who can afford it sacrifice an animal, such as a camel, cow, goat, or sheep. The sacrifice honors Abraham's willingness to sacrifice his older son, Ishmael, and God's decision to substitute a ram instead. In the Christian and Jewish scriptures, the intended sacrifice is Abraham's younger son, Isaac. The Qur'ān, the holy book of Islam, explains that the sacrifice is not an offering of meat to God, but a pious act of sharing food. Those who sacrifice share equally with the poor and with their neighbors. During the festival, children receive gifts and people visit family and friends.

Hugh Talat Halman

See also **`Id al-Fitr**.

**`Id al-Fitr,** *IHD uhl FIHT uhr,* is the first of the two major festivals in Islam. The other major festival is `Id al-Adha. `Id al-Fitr runs for the first three days of Shawwal, the 10th month of the Islamic calendar. It is also called *the smaller festival,* in comparison with `Id al-Adha, which lasts four days. In Turkey, `Id al-Fitr is called the *sweets festival*.

`Id al-Fitr begins on the day after the month of Ramadan. During Ramadan, Muslims abstain from eating and drinking from dawn to sunset. Muslims celebrate their accomplishment of the monthlong fast by offering gifts and charity and sharing festive meals. `Id al-Fitr means Feast of Fast-Breaking.

In the morning of the first day of `Id al-Fitr, Muslims gather in open spaces or in a mosque an hour after sunrise to perform a special community festival prayer service, including a special prayer that is called the *salat al-id.*

The three days of the festival are filled with visits and meals shared with family, friends, and neighbors. Children receive gifts. Hugh Talat Halman

See also **`Id al-Adha**; **Ramadan**.

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The Sawtooth Mountains rise beyond a ranch near Hailey, creating a picturesque winter scene. Towering mountains, beautiful lakes and rivers, and colorful forests make Idaho one of the most scenic states. Many people visit Idaho to enjoy skiing, fishing, hiking, and other outdoor activities.

Idaho *The Gem State*

Idaho is a Rocky Mountain state of the United States with exciting scenery and enormous natural resources. Idaho has towering, snow-capped mountain ranges, swirling white rapids, peaceful lakes, and steep canyons. The canyons of Idaho's Snake River include Hells Canyon, which is deeper than the Grand Canyon. Shoshone Falls, on the Snake River, plunges down rugged cliffs from a height greater than that of Niagara Falls. Among the mountains in the northern part of the state lies quiet Lake Pend Oreille, one of the world's most beautiful lakes. Boise, which is in southwestern Idaho, is the state's capital and largest city.

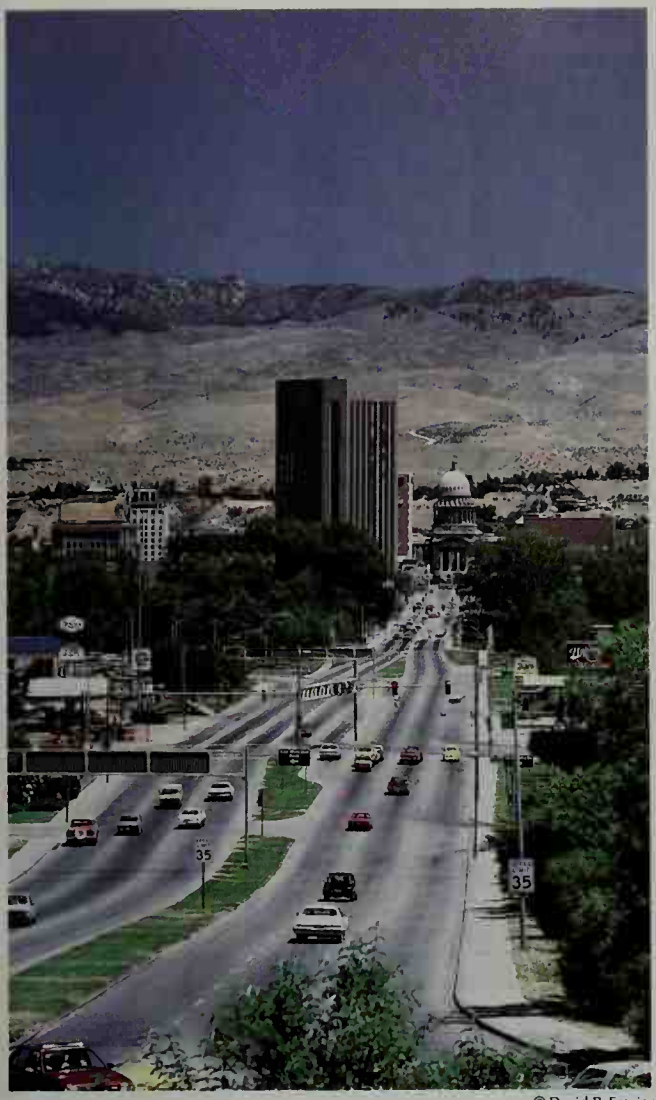
Idaho's natural resources include fertile soil, rich mineral deposits, thick forests, and great water supplies. Idaho farmers grow sugar beets, wheat, and many other crops. But Idaho's most famous crop is potatoes. Idaho ranks first among the states in potato production. Beef and dairy cattle are also a major source of farm income in Idaho.

The processing of such electronic goods as computer microchips is the chief manufacturing activity in Idaho. The production of farm and forest products continues to be of great importance to the state's economy.

Most of Idaho's workers are employed in service industries, which include education, recreation, and retail trade. Spending by tourists benefits many service industries. Idaho also has an important mining industry. The state's leading mineral products include silver, phosphate rock, and gold.

Idaho has one of the most colorful histories of any of the states. Prospectors discovered gold in Idaho during the 1860's. Thousands of miners then poured into the region hoping to strike it rich. Farmers and ranchers came after the miners. As the mines in the area were worked out, many of the miners moved on to other areas. But

The contributors of this article are Ronald L. Hatzenbuehler, Professor of History at Idaho State University; and Harley Johansen, Professor of Geography at the University of Idaho.



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Boise is the capital and largest city of Idaho. The city lies in a fertile valley just south of the Boise Mountains in southwestern Idaho. The domed State Capitol rises in the background.

Interesting facts about Idaho

WORLD BOOK illustration by Kevin Chadwick

The St. Joe River, which empties into Coeur d'Alene Lake, is the world's highest commercially navigable river. The St. Joe is navigable for about 50 miles (80 kilometers) east of the lake. The river flows more than 2,100 feet (630 meters) above sea level.

The longest main street in the United States is located in Island Park. The street runs 33 miles (53 kilometers) through the village, which consists mainly of a long stretch of resorts that became incorporated into one town.

Crystal Ice Cave, near American Falls, has a frozen river, frozen waterfall, and other beautiful formations of ice and stone. The cave is located 160 feet (49 meters) below the lava beds of the Columbia Plateau region. Some of the ice formations in the cave are hundreds of years old. While the temperature aboveground may reach 95 to 97 °F (35 to 36 °C), the temperature in the ice cave remains at 32 °F (0 °C) throughout the year.

Crystal Ice Cave

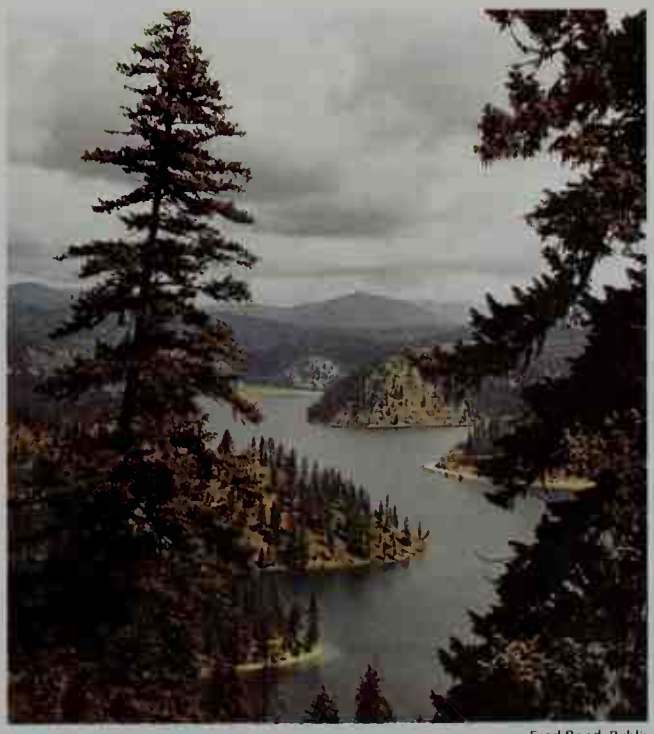
Lava Hot Springs is the home of world-famous hot springs. More than 6 million gallons (23 million liters) of steaming mineral water pour out of the springs each day.

The Big Wood River has been called the *upside down river.* In one stretch, the river is about 100 feet (30 meters) deep and 4 feet (1.2 meters) wide, while a nearby section of the river is about 100 feet (30 meters) wide and 4 feet (1.2 meters) deep.

the farmers and ranchers stayed—and built a state.

Idaho became a state in 1890. It grew quickly as its natural resources were developed. Its forests were tapped, and it became a leading timber-producing state. Mining became an industry. The get-rich-quick prospectors for gold and silver were replaced by scientists. These modern prospectors found that Idaho had many other valuable minerals besides gold and silver. Rich, fertile soils and tremendous water resources, harnessed for irrigation, prompted the growth of agriculture. Today, agriculture is still an important part of Idaho's economy. But manufacturing and service industries have grown rapidly. As a result, the focus of Idaho's economy has shifted from the state's rural areas to its urban areas.

The name *Idaho* was first suggested in 1860 for the area that became the Colorado Territory in 1861. But the name was rejected because it was not an Indian word. In 1863, the name was chosen for the territory that included what is now the state of Idaho. The popular name of Idaho is the *Gem State.*



Fred Bond, Publix

Coeur d'Alene Lake lies in the Rocky Mountains region of Idaho. This region is an important recreation area.

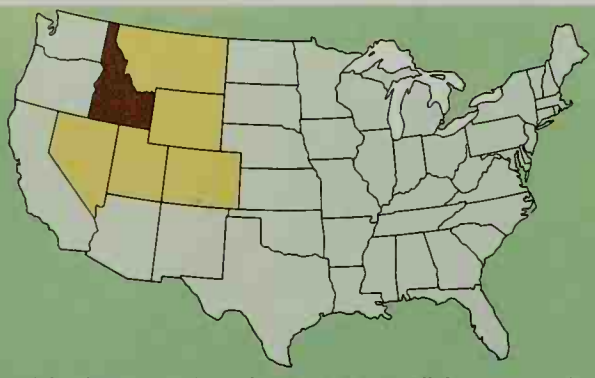
Idaho in brief

Symbols of Idaho

The state flag, first adopted in 1907, bears the state seal. On the seal, originally adopted in 1891, the woman holding the scales and a spear symbolizes justice, liberty, and equality. The miner represents Idaho's mineral resources. The elk's head stands for wildlife and the pine tree for the state's forests. A sheaf of grain symbolizes agriculture. Both the flag and the seal were standardized and readopted in 1957.

State flag

State seal



Idaho (brown) ranks 13th in size among all the states and is the smallest of the Rocky Mountain States (yellow).

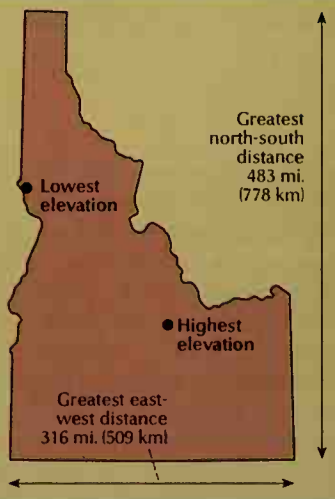
General information

Statehood: July 3, 1890, the 43rd state.
State abbreviations: Ida. (traditional); ID (postal).
State motto: *Esto Perpetua* (Let It Be Perpetual).
State song: "Here We Have Idaho." Words by McKinley Helm and Albert J. Tompkins; music by Sallie Hume-Douglas.

The State Capitol is in Boise, Idaho's capital since 1865. Lewiston served as capital from 1863 to 1865.

Land and climate

Area: 83,574 sq. mi. (216,456 km²), including 823 sq. mi. (2,131 km²) of inland water.
Elevation: *Highest*—Borah Peak, 12,662 ft. (3,859 m) above sea level. *Lowest*—Snake River at Lewiston in Nez Perce County, 710 ft. (216 m) above sea level.
Record high temperature: 118 °F (48 °C) at Orofino on July 28, 1934.
Record low temperature: −60 °F (−51 °C) at Island Park Dam on Jan. 18, 1943.
Average July temperature: 67 °F (19 °C).
Average January temperature: 23 °F (−5 °C).
Average yearly precipitation: 19 in. (48 cm).



Important dates

1805 — Lewis and Clark passed through the Idaho region on their way to the Pacific Coast.

1809 — David Thompson built the first Idaho fur-trading post on the shores of Pend Oreille Lake.

1860 — Franklin, the first permanent settlement in Idaho, was founded. Gold was discovered on Orofino Creek.

1863 — Congress established the Idaho Territory.

State bird
Mountain bluebird

State flower
Syringa

State tree
Western white pine

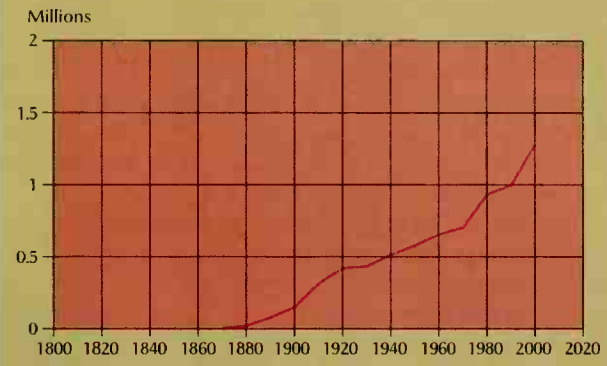
People

Population: 1,293,953 (2000 census)
Rank among the states: 39th
Density: 15 per mi² (6 per km²), U.S. average 78 per mi² (30 per km²)
Distribution*: 57 percent urban, 43 percent rural
Largest cities in Idaho

Boise	185,787
Nampa	51,867
Pocatello	51,466
Idaho Falls	50,730
Meridian	34,919
Coeur d'Alene	34,514

Source: 2000 census, except for *, where figures are for 1990.

Population trend



Source: U.S. Census Bureau.

Year	Population
2000	1,293,953
1990	1,011,986
1980	944,038
1970	713,015
1960	667,191
1950	588,637
1940	524,873
1930	445,032
1920	431,866
1910	325,594
1900	161,772
1890	88,548
1880	32,610
1870	14,999

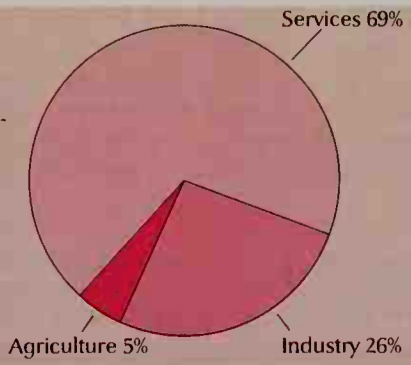
Economy

Chief products
Agriculture: beef cattle, potatoes, milk, wheat, hay, barley, sugar beets.
Manufacturing: computer and electronic equipment, food products, wood products, fabricated metal products.
Mining: silver, phosphate rock, gold.

Gross state product

Value of goods and services produced in 1998: $30,936,000,000. *Services* include community, business, and personal services; finance; government; trade; and transportation, communication, and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, fishing, and forestry.

Source: U.S. Bureau of Economic Analysis.



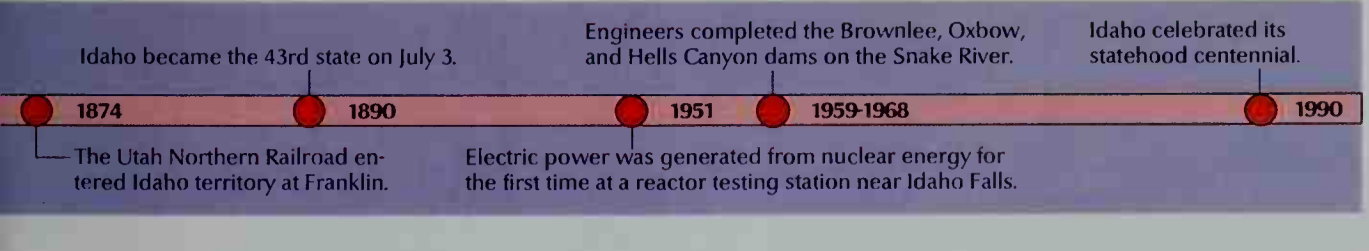
Government

State government
Governor: 4-year term
State senators: 35; 2-year terms
State representatives: 70; 2-year terms
Counties: 44

Federal government
United States senators: 2
United States representatives: 2
Electoral votes: 4

Sources of Information

For information about tourism, write to: Idaho Department of Commerce, 700 W. State Street, P.O. Box 83720, Boise, ID 83720-0093. The Web site at www.visitid.org also provides information. The Department of Commerce also handles requests for information about the state's economy and history.
The state's official Web site at www.state.id.us also provides a gateway to much information on Idaho's economy, government, and history.



Population. The 2000 United States census reported that Idaho had 1,293,953 people. The population had increased by more than 28 percent over the 1990 figure, 1,006,749. According to the 2000 census, Idaho ranks 39th in population among the 50 states.

Idaho has no great manufacturing industries to encourage the growth of large cities. The Census Bureau reported that in 2000 Idaho had only 16 cities with more than 10,000 people. Most of these cities are located along or near the Snake River.

About two-fifths of Idaho's people live in one of the state's two metropolitan areas. One-third of the people live within the Boise metropolitan area (see **Metropolitan area**). Boise is Idaho's largest city and capital. During the early 1960's, rapidly growing Boise annexed all or parts of the surrounding areas of Franklin, Mountain View, and Whitney. Nampa, Idaho's second largest city, is located within the Boise metropolitan area.

Pocatello, the state's third largest city, is the center of Idaho's other metropolitan area. Pocatello is eastern Idaho's major industrial center.

Many Idahoans are descendants of settlers from the Eastern and Midwestern States. Other large population groups include immigrants from Germany, the Scandinavian countries, and the United Kingdom. Approximately 17,600 Indians live in Idaho.

Schools. When Idaho became a state, Congress gave two sections (1,280 acres, or 518 hectares) of each township for the support of schools. Little of this land has been used for school sites. However, it provides income for schools. Almost all funds for Idaho schools come from taxation. Children age 7 to 15 must attend school.

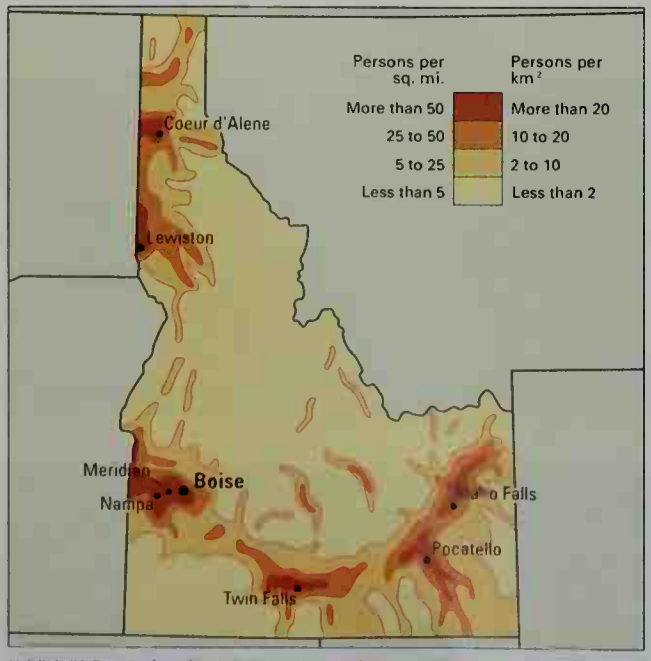
The State Board of Education oversees and assists the public schools in the state. The board is made up of seven appointed members and the state superintendent of public instruction. The governor names the appointed members to five-year terms. The voters elect the superintendent to a four-year term. For information on the number of students and teachers in Idaho, see **Education** (table).

Libraries. Idaho has public libraries throughout the state. Other libraries include the Idaho State Library and the Idaho State Law Library in Boise, and several university and college libraries. The University of Idaho has a large collection of materials on land use and wilderness conservation in the Pacific Northwest. The Idaho State Historical Society operates a library and archives in Boise. The Human Rights Collection at the Coeur d'Alene Public Library includes materials on the Holocaust, hate groups in the United States, and human rights.

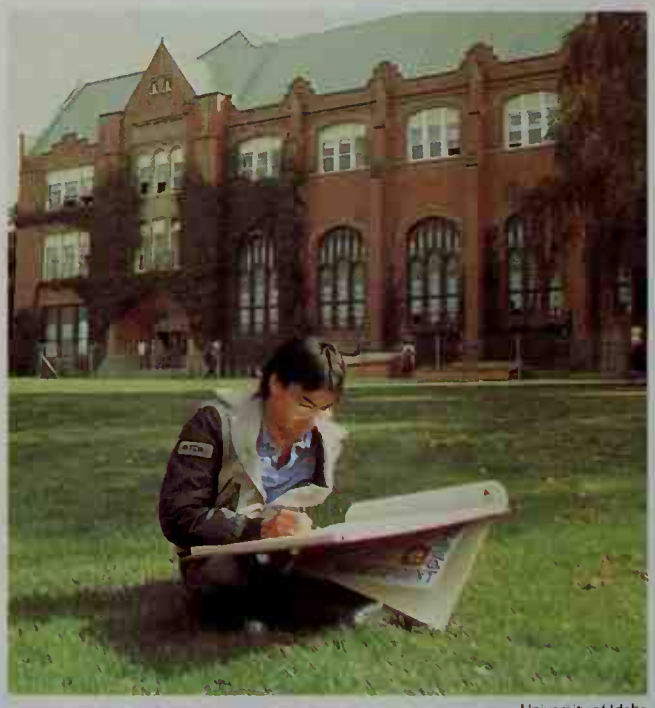
Museums. The Idaho State Historical Society in Boise maintains a museum of Idaho history. Other museums include the Boise Art Museum, the Idaho Museum of Natural History in Pocatello, the Herrett Center for Arts and Sciences in Twin Falls, and the Craters of the Moon National Monument Museum in Arco. Numerous local museums are located throughout the state.

Population density

About two-fifths of Idaho's people live in metropolitan areas. Most of the population centers lie along or near the Snake River. Boise is Idaho's largest city and its capital.



WORLD BOOK map based on U.S. Census Bureau data



University of Idaho

The University of Idaho in Moscow was founded in 1889 and ranks as the state's oldest university or college. The Administration Building, *shown here,* is the oldest building on the campus.

Universities and colleges

This table lists the universities and colleges in Idaho that grant bachelor's or advanced degrees and are accredited by the Northwest Association of Schools and Colleges.

Name	Mailing address
Albertson College	Caldwell
Boise State University	Boise
Idaho, University of	Moscow
Idaho State University	Pocatello
Lewis-Clark State College	Lewiston
Northwest Nazarene University	Nampa

Idaho map index

Metropolitan areas

Boise 432,345
Pocatello 75,565

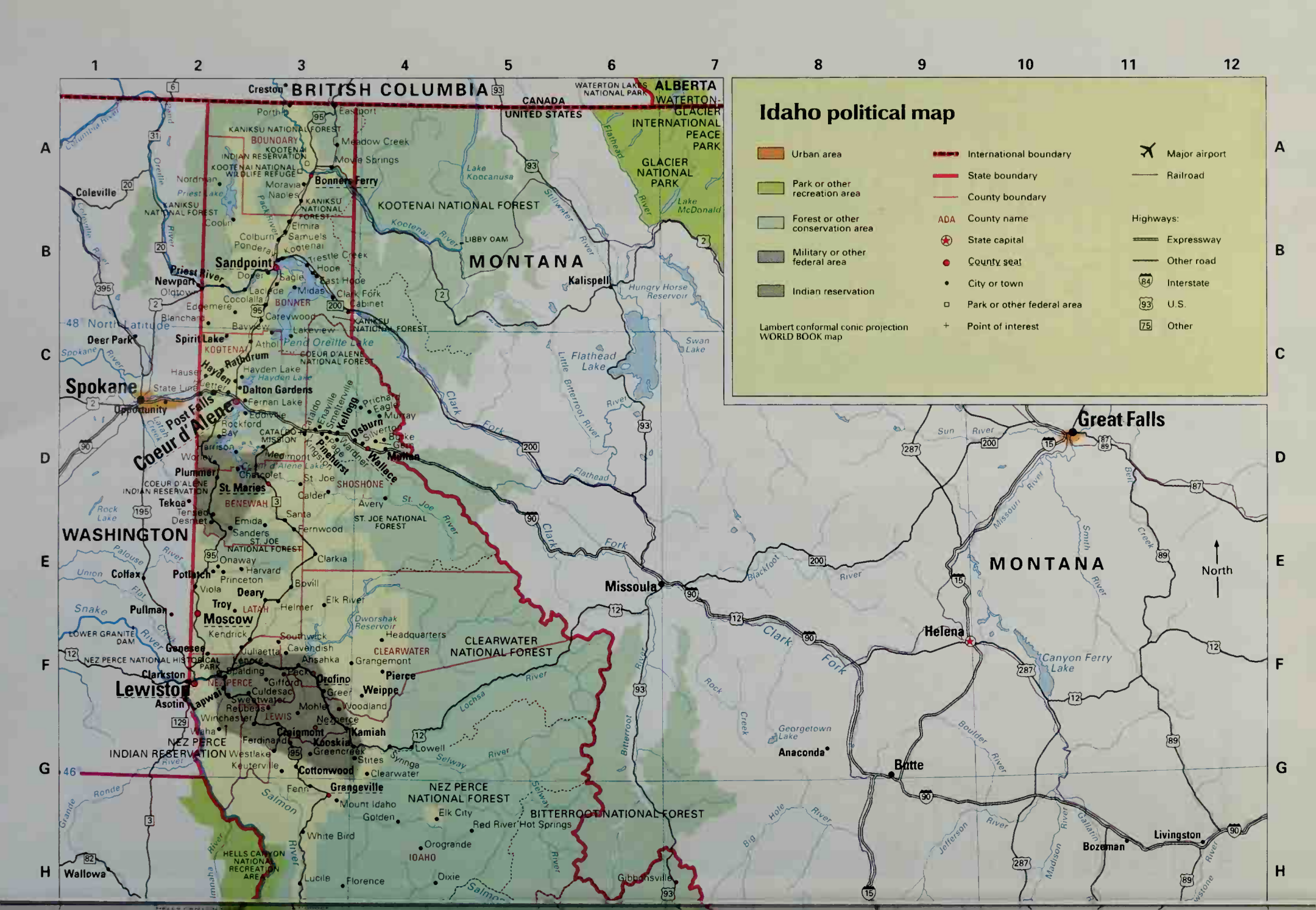
Counties

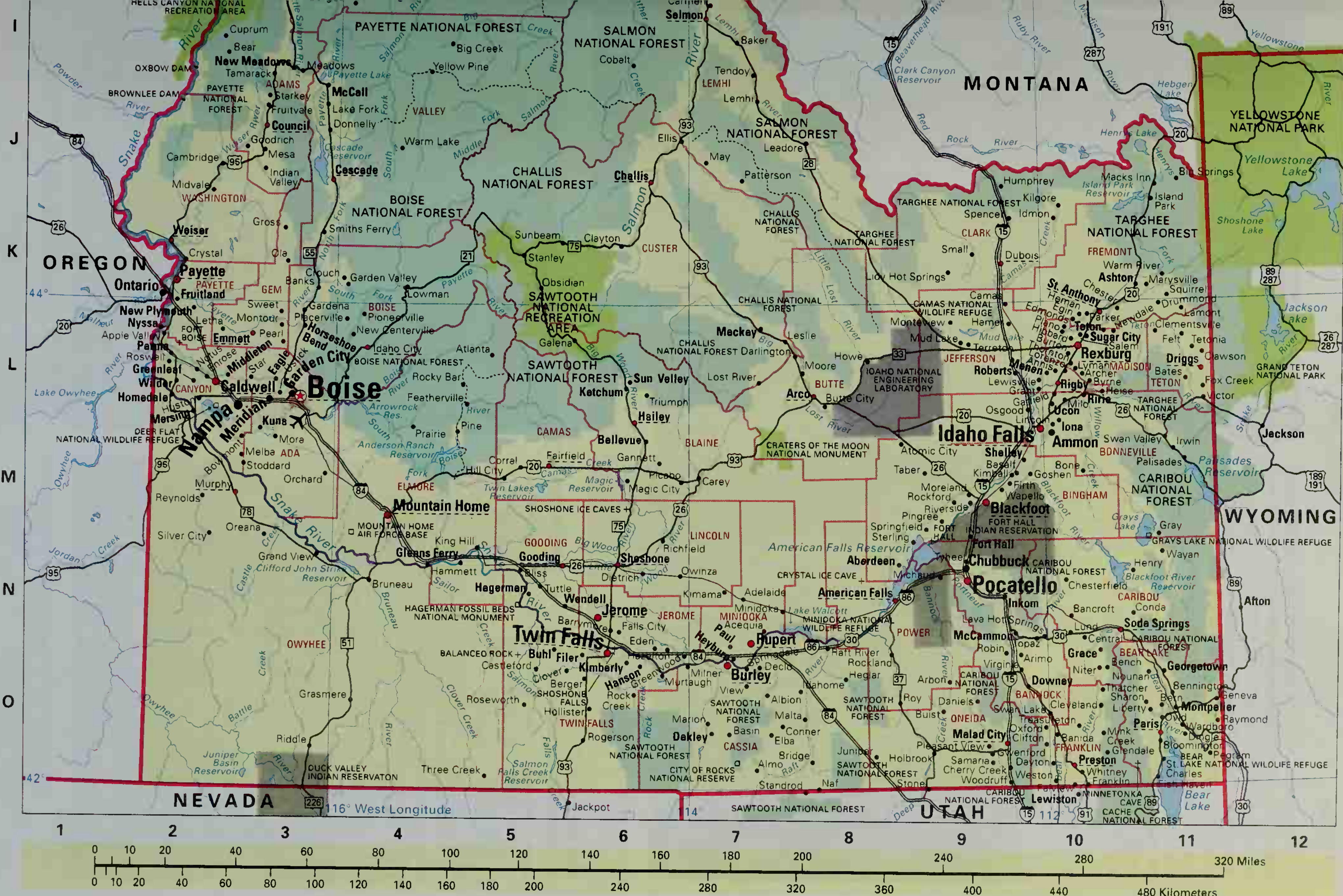
Ada ..... 300,904 ..M 3
Adams ..... 3,476 ..J 3
Bannock ..... 75,565 ..O 9
Bear Lake ..... 6,411 ..N 10
Benewah ..... 9,171 ..D 2
Bingham ..... 41,735 ..M 10
Blaine ..... 18,991 ..M 7
Boise ..... 6,670 ..K 4
Bonner ..... 36,835 ..C 3
Bonneville ..... 82,522 ..M 10
Boundary ..... 9,871 ..A 3
Butte ..... 2,899 ..L 8
Camas ..... 991 ..M 5
Canyon ..... 131,441 ..L 2
Caribou ..... 7,304 ..N 10
Cassia ..... 21,416 ..O 7
Clark ..... 1,022 ..K 9
Clearwater ..... 8,930 ..F 4
Custer ..... 4,342 ..K 6
Elmore ..... 29,130 ..M 4
Franklin ..... 11,329 ..O 10
Fremont ..... 11,819 ..K 10
Gem ..... 15,181 ..K 3
Gooding ..... 14,155 ..M 5
Idaho ..... 15,511 ..H 4
Jefferson ..... 19,155 ..L 9
Jerome ..... 18,342 ..N 6
Kootenai ..... 108,685 ..C 2
Latah ..... 34,935 ..F 2
Lemhi ..... 7,806 ..I 6
Lewis ..... 3,747 ..G 3
Lincoln ..... 4,044 ..M 7
Madison ..... 27,467 ..L 10
Minidoka ..... 20,174 ..N 7
Nez Perce ..... 37,410 ..F 2
Oneida ..... 4,125 ..O 8
Owyhee ..... 10,644 ..N 3
Payette ..... 20,578 ..L 2
Power ..... 7,538 ..N 8
Shoshone ..... 13,771 ..E 4
Teton ..... 5,999 ..L 11
Twin Falls ..... 64,284 ..O 5
Valley ..... 7,651 ..J 4
Washington ..... 9,977 ..K 2

Cities and towns

Aberdeen ..... 1,840 ..N 8
Acequia ..... 144 ..N 7
Adelaide ..... N 7
Ahsahka ..... F 3
Albion ..... 262 ..O 7
Almo ..... O 7
American Falls° ..... 4,111 ..N 8
Ammon ..... 6,187 ..M 10
Annis ..... L 10
Apple Valley ..... L 2
Arbon ..... O 9
Archer ..... L 10
Arco° ..... 1,026 ..L 8
Arimo ..... 348 ..N 9
Ashton ..... 1,129 ..K 10
Athol ..... 676 ..C 3
Atlanta ..... L 5
Atomic City ..... 25 ..M 8
Avery ..... D 4
Baker ..... I 7
Bancroft ..... 382 ..N 10
Banida ..... O 10
Banks ..... K 3
Barrymore ..... N 6
Basalt ..... 419 ..M 9
Basin ..... O 7
Bates ..... L 11
Bayview ..... C 3
Bear ..... I 2
Bellevue ..... 1,876 ..M 6
Bench ..... O 10
Bennington ..... O 11
Berger ..... O 6
Bern ..... O 11
Big Creek ..... I 4
Big Springs ..... J 11
Blackfoot° ..... 10,419 ..M 9
Blanchard ..... C 2
Bliss ..... 275 ..N 5
Bloomington ..... 251 ..O 11
Blue Dome ..... K 8
Boise° ..... 185,787 ..L 3
Bone ..... M 10
Bonners Ferry° ..... 2,515 ..A 3
Bovill ..... 305 ..E 3
Bowmont ..... M 3
Bridge ..... O 8
Bruneau ..... N 4
Buhl ..... 3,985 ..N 5
Buist ..... O 9
Burke ..... D 4
Burley° ..... 9,316 ..O 7
Burton ..... L 10
Butte City ..... 76 ..L 8
Byrne ..... L 10
Cabinet ..... C 4
Calder ..... D 3
Caldwell° ..... 25,967 ..L 2
Camas ..... K 9
Cambridge ..... 360 ..J 2
Carey ..... 513 ..M 7
Careywood ..... C 3
Carmen ..... I 7
Cascade° ..... 997 ..J 3
Castleford ..... 277 ..O 5
Cataldo ..... D 3
Cavendish ..... F 3
Central ..... N 10
Challis° ..... 909 ..J 6
Chatcolet ..... D 2
Cherry Creek ..... O 9
Chester ..... K 10
Chesterfield ..... N 10
Chubbuck ..... 9,700 ..N 9
Clark Fork ..... 530 ..C 3
Clarkia ..... E 3
Clawson ..... L 11
Clayton ..... 27 ..K 6
Clearwater ..... G 4
Clementsville ..... L 11
Cleveland ..... O 10
Clifton ..... 213 ..O 10
Clover ..... O 5
Cobalt ..... I 6
Cocolalla ..... C 3
Coeur d'Alene° ..... 34,514 ..D 2
Coeur d'Alene Indian Reservation ..... 6,551 ..D 2
Colburn ..... B 3
Conda ..... N 10
Conner ..... O 7
Coolin ..... B 2
Corral ..... M 5
Cottonwood ..... 944 ..G 3
Council° ..... 816 ..J 3
Craigmont ..... 556 ..G 3
Crouch ..... 154 ..K 3
Crystal ..... K 2
Culdesac ..... 378 ..F 3
Cuprum ..... I 2
Dalton Gardens ..... 2,278 ..C 2
Daniels ..... O 9
Darlington ..... L 7
Dayton ..... 444 ..O 10
Deary ..... 552 ..E 3
Declo ..... 338 ..O 7
Desmet ..... E 2
Dietrich ..... 150 ..N 6
Dingle ..... O 11
Dixie ..... H 4
Donnelly ..... 138 ..J 3
Dover ..... 342 ..B 3
Downey ..... 613 ..O 10
Driggs° ..... 1,100 ..L 11
Drummond ..... 15 ..K 11
Dubois° ..... 647 ..K 9
Duck Valley Indian Reservation ..... 248 ..O 3
Eagle ..... D 4
Eagle ..... 11,085 ..L 3
East Hope ..... 200 ..B 3
Eastport ..... A 3
Eddiville ..... D 3
Eden ..... 411 ..N 6
Edgemere ..... C 2
Edmonds ..... L 10
Egin ..... K 10
Elba ..... O 7
Elk City ..... H 4
Elk River ..... 156 ..E 3
Ellis ..... J 6
Elmira ..... B 3
Emida ..... E 3
Emmett° ..... 5,490 ..L 3
Enaville ..... D 3
Enrose ..... L 2
Fairfield° ..... 395 ..M 5
Fairview ..... O 10
Falls City ..... N 6
Featherville ..... L 5
Felt ..... L 11
Fenn ..... G 3
Ferdinand ..... 145 ..G 3
Fernan Lake ..... 186 ..D 3
Fernwood ..... E 3
Filer ..... 1,620 ..N 6
Firth ..... 408 ..M 9
Fish Haven ..... O 11
Fort Hall† ..... 3,193 ..M 9
Fort Hall Indian Reservation ..... 5,760 ..N 9
Fox Creek ..... L 11
Franklin ..... 641 ..O 10
Fruitland ..... 3,805 ..K 2
Fruitvale ..... J 3
Galena ..... L 6
Gannett ..... M 6
Garden City ..... 10,624 ..L 3
Garden Valley ..... K 4
Gardena ..... K 3
Garfield ..... L 10
Gem ..... D 4
Genesee ..... 946 ..F 2
Geneva ..... O 11
Georgetown ..... 538 ..O 11
Gibbonsville ..... H 7
Gifford ..... F 3
Glendale ..... O 10
Glenns Ferry ..... 1,611 ..N 5
Golden ..... H 4
Gooding° ..... 3,384 ..N 5
Goshen ..... M 10
Grace ..... 990 ..N 10
Grand View ..... 470 ..N 3
Grangemont ..... F 4
Grangeville° ..... 3,228 ..G 3
Grant ..... L 10
Grasmere ..... O 4
Gray ..... M 11
Greencreek ..... G 3
Greenleaf ..... 862 ..L 2
Greenwood ..... N 6
Greer ..... F 3
Gross ..... K 3
Gwenford ..... O 9
Hagerman ..... 656 ..N 5
Hailey° ..... 6,200 ..L 6
Hamer ..... 12 ..L 9
Hammett ..... N 4
Hansen ..... 970 ..O 6
Harrison ..... 267 ..D 2
Harvard ..... E 2
Hauser ..... 668 ..C 2
Hayden ..... 9,159 ..C 2
Hayden Lake ..... 494 ..C 2
Hazelton ..... 687 ..N 6
Headquarters ..... F 4
Heglar ..... O 8
Heise ..... L 10
Helmer ..... E 3
Heman ..... K 10
Henry ..... N 10
Heyburn ..... 2,899 ..N 7
Hibbard ..... L 10
Hill City ..... M 5
Holbrook ..... O 9
Hollister ..... 237 ..O 6
Homedale ..... 2,528 ..L 2
Hope ..... 79 ..B 3
Horseshoe Bend ..... 770 ..L 3
Howe ..... L 8
Huetter ..... 96 ..C 2
Humphrey ..... J 9
Huston ..... L 2
Idaho City° ..... 458 ..L 4
Idaho Falls° ..... 50,730 ..L 10
Idahome ..... O 8
Idmon ..... K 10
Indian Valley ..... J 3
Inkom ..... 738 ..N 9
Iona ..... 1,201 ..L 10
Irwin ..... 157 ..M 11
Island Park ..... 215 ..J 11
Jerome° ..... 7,780 ..N 6
Juliaetta ..... 609 ..F 2
Juniper ..... O 8
Kamiah ..... 1,160 ..G 3
Kellogg ..... 2,395 ..D 3
Kendrick ..... 369 ..F 3
Ketchum ..... 3,003 ..L 6
Keuterville ..... G 3
Kilgore ..... J 10
Kimama ..... N 7
Kimball ..... M 9
Kimberly ..... 2,614 ..O 6
King Hill ..... N 5
Kingston ..... D 3
Kooskia ..... 675 ..G 4
Kootenai ..... 441 ..B 3
Kootenai Indian Reservation ..... 75 ..A 3
Kuna ..... 5,382 ..M 3
Laclede ..... B 3
Lake Fork ..... J 3
Lakeview ..... C 3
Lamont ..... K 11
Lapwai ..... 1,134 ..F 2
Lava Hot Springs ..... 521 ..N 10
Leadore ..... 90 ..J 8
Lemhi ..... J 7
Lenore ..... F 3
Leslie ..... L 7
Letha ..... L 2
Lewiston° ..... 30,904 ..F 2
Lewisville ..... 467 ..L 10
Liberty ..... O 11
Lidy Hot Springs ..... K 9
Lincoln ..... L 10
Lorenzo ..... L 10
Lost River ..... 26 ..L 7
Lowell ..... G 4
Lowman ..... K 4
Lucile ..... H 3
Lund ..... N 10
Lyman ..... L 10
Mackay ..... 566 ..L 7
Macks Inn ..... J 11
Magic City ..... M 6
Malad City° ..... 2,158 ..O 9
Malta ..... 177 ..O 8
Marion ..... O 7
Marsing ..... 890 ..L 2
Marysville ..... K 11
May ..... J 7
McCall ..... 2,084 ..J 3
McCammon ..... 805 ..N 9
Meadow Creek ..... A 3
Meadows ..... I 3
Medimont ..... D 3
Melba ..... 439 ..M 3
Menan ..... 707 ..L 10
Meridian ..... 34,919 ..L 3
Mesa ..... J 3
Michaud ..... N 9
Midas ..... B 3
Middleton ..... 2,978 ..L 2
Midvale ..... 176 ..J 2
Milner ..... O 7
Milo ..... L 10
Minidoka ..... 129 ..N 7
Mink Creek ..... O 10
Mohler ..... F 3
Monteview ..... L 9
Montour ..... L 3
Montpelier ..... 2,785 ..O 11
Moore ..... 196 ..L 8
Mora ..... M 3
Moravia ..... A 3
Moreland ..... M 9
Moscow° ..... 21,291 ..F 2
Mount Idaho ..... G 3
Mountain Home° ..... 11,143 ..M 4
Mountain Home AFB† ..... 8,894 ..M 4
Moyie Springs ..... 656 ..A 3
Mud Lake ..... 270 ..L 9
Muldoon ..... L 7
Mullan ..... 840 ..D 4
Murphy° ..... M 3
Murray ..... D 4
Murtaugh ..... 139 ..O 6
Naf ..... O 8
Nampa ..... 51,867 ..L 3
Naples ..... B 3
New Centerville ..... L 4
New Meadows ..... 533 ..I 3
New Plymouth ..... 1,400 ..K 2
Newdale ..... 358 ..L 10
Nezperce° ..... 523 ..G 3
Nez Perce Indian Reservation ..... 17,959 ..F 3
Niter ..... O 10
Nordman ..... A 2
North Fork ..... H 7
Notus ..... 458 ..L 2
Nounan ..... O 11
Oakley ..... 668 ..O 7
Obsidian ..... K 5
Ola ..... K 3
Oldtown ..... 190 ..B 2
Onaway ..... 230 ..E 2
Orchard ..... M 3
Oreana ..... M 3
Orofino° ..... 3,247 ..F 3
Orogrande ..... H 4
Osburn ..... 1,545 ..D 4
Osgood ..... L 19
Ovid ..... O 11
Owinza ..... N 6
Oxford ..... 53 ..O 10
Page ..... D 3
Palisades ..... M 11
Paris° ..... 576 ..O 11
Parker ..... 319 ..K 10
Parma ..... 1,771 ..L 2
Patterson ..... J 7
Paul ..... 998 ..N 7
Payette° ..... 7,054 ..K 2
Pearl ..... L 3
Peck ..... 186 ..F 3
Pegram ..... O 11
Picabo ..... M 6
Pierce ..... 617 ..F 4
Pine ..... M 5
Pinehurst ..... 1,661 ..D 3
Pingree ..... M 9
Pioneerville ..... L 4
Placerville ..... 60 ..L 4
Plano ..... L 10
Pleasant View ..... O 9
Plummer ..... 990 ..D 2
Pocatello° ..... 51,466 ..N 9
Pollock ..... I 3
Ponderay ..... 638 ..B 3
Porthill ..... A 3
Post Falls ..... 17,247 ..C 2
Putlatch ..... 791 ..E 2
Prairie ..... M 4
Preston° ..... 4,682 ..O 10
Prichard ..... D 4
Priest River ..... 1,754 ..B 2
Princeton ..... E 2
Raft River ..... N 8
Rathdrum ..... 4,816 ..C 2
Raymond ..... O 11
Red River Hot Springs ..... H 5
Reubens ..... 72 ..F 3
Rexburg° ..... 17,257 ..L 10
Reynolds ..... M 2
Richfield ..... 412 ..M 6
Riddle ..... O 3
Rigby° ..... 2,998 ..L 10
Riggins ..... 410 ..H 3
Ririe ..... 545 ..L 10
Riverside ..... M 9
Roberts ..... 647 ..L 9
Robin ..... N 9
Rock Creek ..... O 6
Rockford ..... M 9
Rockford Bay ..... D 2
Rockland ..... 316 ..O 8
Rocky Bar ..... L 5
Rogerson ..... O 6
Roseworth ..... O 5
Roswell ..... L 2
Roy ..... O 8
Rupert° ..... 5,645 ..N 7
Sagle ..... B 3
St. Anthony° ..... 3,342 ..K 10
St. Charles ..... 156 ..O 11
St. Joe ..... D 3
St. Maries° ..... 2,652 ..D 3
Salem ..... L 10
Salmon° ..... 3,122 ..I 7
Samaria ..... D 9
Samuels ..... B 3
Sanders ..... E 2
Sandpoint° ..... 6,835 ..B 3
Santa ..... E 3
Sharon ..... O 11
Shelley ..... 3,813 ..M 10
Shoshone° ..... 1,398 ..N 6
Shoup ..... I 6
Silver City ..... M 3
Silverton ..... D 4
Small ..... K 9
Smelterville ..... 651 ..D 3
Smiths Ferry ..... K 3
Soda Springs° ..... 3,381 ..N 10
Soldier ..... M 5
Southwick ..... F 3
Spalding ..... F 2
Spencer ..... 38 ..K 9
Spirit Lake ..... 1,376 ..C 2
Springdale ..... O 7
Springfield ..... M 9
Squirrel ..... K 11
Standrod ..... O 8
Stanley ..... 100 ..K 5
Star ..... 1,795 ..L 3
State Line ..... 28 ..C 2
Sterling ..... M 8
Stites ..... 226 ..G 4
Stoddard ..... M 3
Stone ..... O 9
Sugar City ..... 1,242 ..L 10
Sun Valley ..... 1,427 ..L 6
Sunbeam ..... K 5
Swan Lake ..... O 10
Swan Valley ..... 213 ..L 11
Sweet ..... K 3
Sweetwater ..... F 2
Syringa ..... G 4
Taber ..... M 9
Tamarack ..... I 3
Tendoy ..... I 7
Tensed ..... 126 ..E 2
Terreton ..... L 9
Teton ..... 569 ..L 10
Tetonia ..... 247 ..L 11
Thatcher ..... O 10
Thornton ..... L 10
Three Creek ..... O 5
Topaz ..... N 10
Treasureton ..... O 10
Trestle Creek ..... B 3
Triumph ..... L 6
Troy ..... 798 ..F 2
Tuttle ..... N 5
Twin Falls° ..... 34,469 ..N 6
Tyhee ..... N 9
Ucon ..... 943 ..L 10
Ustick ..... L 3
Victor ..... 840 ..L 11
View ..... O 7
Viola ..... E 2
Virginia ..... O 9
Waha ..... G 2
Wallace° ..... 960 ..D 4
Wapello ..... M 9
Wardboro ..... O 11
Wardner ..... 215 ..D 3
Warm Lake ..... J 4
Warm River ..... 10 ..K 11
Warren ..... I 4
Wayan ..... N 11
Weippe ..... 416 ..F 4
Weiser° ..... 5,343 ..K 2
Wendell ..... 2,338 ..N 5
Westlake ..... G 3
Weston ..... 425 ..O 10
White Bird ..... 106 ..H 3
Whitney ..... O 10
Wilder ..... 1,462 ..L 2
Winchester ..... 308 ..G 3
Woodland ..... F 3
Woodruff ..... O 9
Worley ..... 223 ..D 2
Yellow Pine ..... I 4

°County seat.
†Census designated place—unincorporated, but recognized as a significant settled community by the U.S. Census Bureau.
Places without population figures are unincorporated areas.
Source: 2000 census.


Idaho political map
Urban area
Park or other recreation area
Forest or other conservation area
Military or other federal area
Indian reservation
Lambert conformal conic projection
WORLD BOOK map
International boundary
State boundary
County boundary
ADA County name
State capital
County seat
City or town
Park or other federal area
Point of interest
Major airport
Railroad
Highways:
Expressway
Other road
Interstate
U.S.
Other
BRITISH COLUMBIA
ALBERTA
CANADA
UNITED STATES
WATERTON LAKES NATIONAL PARK
WATERTON-GLACIER INTERNATIONAL PEACE PARK
GLACIER NATIONAL PARK
KOOTENAI NATIONAL FOREST
MONTANA
WASHINGTON
IDAHO
NEZ PERCE INDIAN RESERVATION
NEZ PERCE NATIONAL FOREST
CLEARWATER NATIONAL FOREST
BITTERROOT NATIONAL FOREST
HELLS CANYON NATIONAL RECREATION AREA
COEUR D'ALENE INDIAN RESERVATION
ST. JOE NATIONAL FOREST
48 North Latitude
46
Creston
Coleville
Sandpoint
Priest River
Newport
Deer Park
Spirit Lake
Spokane
Coeur d'Alene
Post Falls
Plummer
St Maries
Tekoa
Colfax
Pullman
Moscow
Lewiston
Asotin
Clarkston
Genesee
Potlatch
Deary
Troy
Orofino
Pierce
Weippe
Kamiah
Kooskia
Grangeville
Cottonwood
Wallowa
Kalispell
Missoula
Helena
Great Falls
Butte
Anaconda
Bozeman
Livingston
Hungry Horse Reservoir
Flathead Lake
Swan Lake
Lake Koocanusa
Lake McDonald
Canyon Ferry Lake
Georgetown Lake
Dworshak Reservoir
Lower Granite Dam
North


MONTANA
WYOMING
OREGON
NEVADA
UTAH
YELLOWSTONE NATIONAL PARK
GRAND TETON NATIONAL PARK
PAYETTE NATIONAL FOREST
SALMON NATIONAL FOREST
CHALLIS NATIONAL FOREST
BOISE NATIONAL FOREST
SAWTOOTH NATIONAL FOREST
SAWTOOTH NATIONAL RECREATION AREA
TARGHEE NATIONAL FOREST
CARIBOU NATIONAL FOREST
CACHE NATIONAL FOREST
CAMAS NATIONAL WILDLIFE REFUGE
GRAYS LAKE NATIONAL WILDLIFE REFUGE
BEAR LAKE NATIONAL WILDLIFE REFUGE
DEER FLAT NATIONAL WILDLIFE REFUGE
MINIDOKA NATIONAL WILDLIFE REFUGE
HELLS CANYON NATIONAL RECREATION AREA
IDAHO NATIONAL ENGINEERING LABORATORY
CRATERS OF THE MOON NATIONAL MONUMENT
HAGERMAN FOSSIL BEDS NATIONAL MONUMENT
CITY OF ROCKS NATIONAL RESERVE
FORT HALL INDIAN RESERVATION
DUCK VALLEY INDIAN RESERVATON
MOUNTAIN HOME AIR FORCE BASE
SHOSHONE ICE CAVES
CRYSTAL ICE CAVE
BALANCED ROCK
MINNETONKA CAVE
OXBOW DAM
BROWNLEE DAM
ADAMS
WASHINGTON
VALLEY
PAYETTE
GEM
BOISE
CANYON
ADA
ELMORE
OWYHEE
CAMAS
BLAINE
CUSTER
LEMHI
BUTTE
CLARK
FREMONT
JEFFERSON
MADISON
TETON
BONNEVILLE
BINGHAM
CARIBOU
BEAR LAKE
POWER
BANNOCK
ONEIDA
FRANKLIN
LINCOLN
GOODING
JEROME
MINIDOKA
CASSIA
TWIN FALLS
Boise
Nampa
Meridian
Caldwell
Garden City
Idaho Falls
Pocatello
Twin Falls
Mountain Home
Rexburg
Blackfoot
Burley
Rupert
Jerome
Ketchum
Sun Valley
Hailey
Bellevue
Salmon
Challis
McCall
Cascade
Council
Weiser
Payette
Ontario
Fruitland
Emmett
Kuna
Eagle
Star
Middleton
Homedale
Marsing
Murphy
Grand View
Bruneau
Glenns Ferry
Hagerman
Gooding
Shoshone
Wendell
Buhl
Filer
Kimberly
Hansen
Heyburn
Paul
Oakley
American Falls
Aberdeen
Chubbuck
Fort Hall
Shelley
Ammon
Iona
Ucon
Rigby
Rirle
St. Anthony
Ashton
Sugar City
Driggs
Victor
Arco
Mackay
Stanley
Malad City
Preston
Soda Springs
Grace
Montpelier
Paris
Georgetown
Downey
McCammon
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Jackson
Jackpot
Lewiston
Snake River
Salmon River
Payette
Bear Lake
American Falls Reservoir
Palisades Reservoir
116° West Longitude
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Idaho's natural wonders thrill thousands of sightseers every year. Visitors can go with experienced guides on exciting boat trips through Hells Canyon and along the Salmon River. Hunters in Idaho shoot deer, bear, elk, pheasant, partridge, and duck in the forests and mountains and on the plains. Fishing enthusiasts catch bass, crappie, whitefish, and numerous varieties of trout in the state's quiet lakes and rushing streams.

Idaho is a skier's paradise. Its ski trails rank among the most popular in the world. Idaho's best-known ski resort is Sun Valley. This resort, which is in the southern part of the state, lies 6,000 feet (1,800 meters) above sea level and is surrounded by high mountain peaks. Other favorite Idaho ski resorts include Bogus Basin, near Boise; Brundage, near McCall; Schweitzer, near Sandpoint; Silver Mountain, near Coeur d'Alene; Pebble Creek, near Pocatello; and Grand Targhee, near Driggs.

Sports events and regional fairs are among Idaho's most important annual events. The state's rodeos are well known.

Wardene Weisser, Berg & Associates

Craters of the Moon National Monument

Places to visit

Cataldo Mission (the popular name of the Old Mission of the Sacred Heart), west of Kellogg, was begun in the 1850's by Indians directed by a Roman Catholic missionary. The mission is Idaho's oldest building.

Caves. Idaho has hundreds of underground caverns. Crystal Ice Cave, near American Falls, has a frozen river, frozen waterfall, and other formations of ice and stone. Minnetonka Cave, in St. Charles Canyon near Paris, has huge sandstone chambers that look like Gothic halls. It also contains many fossils of prehistoric marine life. Shoshone Ice Caves, near Shoshone, lie under lava fields. Ice covers their walls and ceilings.

Coeur d'Alene District Mining Museum has photographs and artifacts concerning the history of mining. A tour takes visitors to the nearby Sierra Silver Mine.

Ghost towns once bustled with activity but were abandoned after miners had worked out the nearby veins of gold and silver. Idaho ghost towns include Silver City in Owyhee County and Idaho City in Boise County.

Hagerman Fossil Beds National Monument includes long stretches of cliffs along the Snake River. The nearby Hagerman Valley Historical Society Museum displays fossils from the cliffs, including some from prehistoric horses.

Hells Canyon, the deepest canyon in North America, is on the Snake River about 100 miles (160 kilometers) south of Lewiston. This narrow canyon has an average depth of about 1 mile (1.6 kilometers). The canyon's greatest depth is 7,900 feet (2,400 meters).

Old Fort Hall, in Pocatello, is a reconstruction of a trading post that became an important stop in Idaho on the Oregon Trail. The Hudson's Bay Company built the original fort in 1834.

Peregrine Fund World Center for Birds of Prey, near Boise, is an endangered species center. There, scientists study exotic species of birds of prey to learn how to prevent extinction. The facility may be toured by appointment.

National forests. All or part of 15 national forests lie in Idaho. They are Bitterroot, Boise, Cache, Caribou, Challis, Clearwater, Coeur d'Alene, Kaniksu, Kootenai, Nez Perce, Payette, St. Joe, Salmon, Sawtooth, and Targhee. Coeur d'Alene, Kaniksu, and St. Joe are administered as Idaho Panhandle National Forests. The U.S. government has set aside large sections of the state's national forests as national wilderness areas.

National parklands. Part of Yellowstone National Park lies in Idaho, but most is in northwestern Wyoming. Craters of the Moon National Monument is south of Arco. Its appearance suggests the surface of the moon. Nez Perce National Historical Park near Lewiston honors the Nez Perce Indian region and pays tribute to the Lewis and Clark Expedition. For more information about national parklands in Idaho, see the map and tables in the *World Book* article on **National Park System.**

State parks. Idaho has 22 state parks that offer fishing, boating, and swimming on lakes, and riding and picnicking in forest areas. Farragut State Park, on Lake Pend Oreille, is the best-known park. Heyburn State Park, on Coeur d'Alene Lake, is the largest. For more information about state parks, write to Idaho Parks and Recreation, 5657 Warm Springs, Boise, ID 83712-8752.

© Jack Williams, Sun Valley Company

Movie theater at Sun Valley ski resort

Annual events

January-April

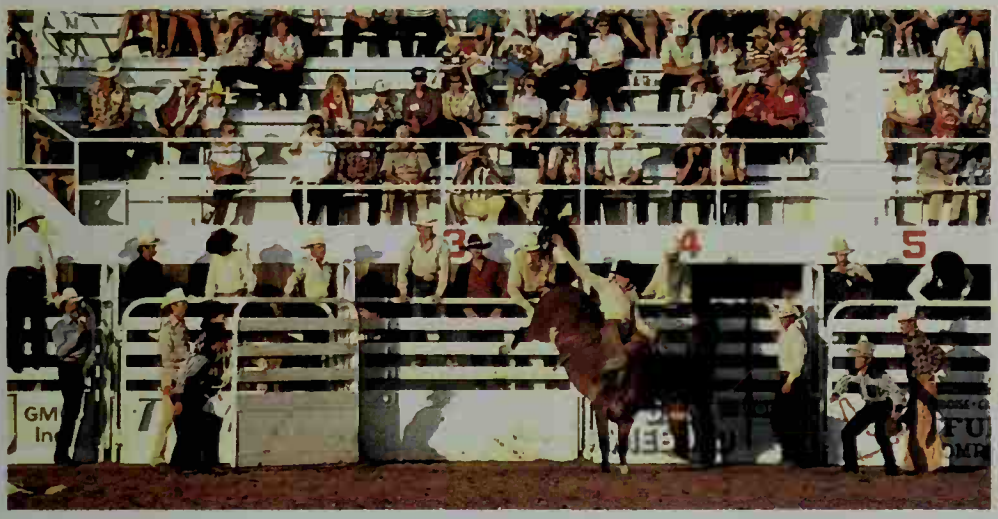
Sun Valley Winter Carnival (January); McCall Winter Carnival (January-February); National Circuit Finals Rodeo in Pocatello (March); Dogwood Festival in Lewiston (April-May).

May-August

Boise River Festival (June), National Oldtime Fiddlers Contest and Festival in Weiser (mid-June); Cherry Blossom Festival in Emmett (late June); Border Days in Grangeville (early July); Snake River Stampede in Nampa (mid-July); Shoshone-Bannock Indian Festival at Fort Hall Indian Reservation near Blackfoot (early August); Western Idaho Fair in Boise (late August to early September).

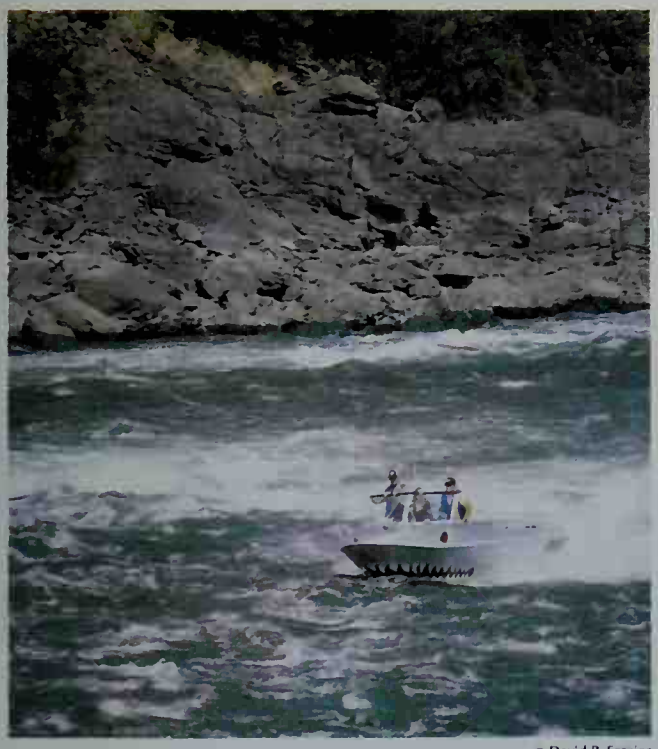
September-December

Eastern Idaho State Fair in Blackfoot (early September); Lewiston Roundup (early September); Art in the Park in Boise (early September); Lumberjack Days in Orofino (mid-September); Idaho Spud Day in Shelley (September).



David R. Frazier

Snake River Stampede in Nampa



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Boating on the Snake River in Hells Canyon

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Oldtime Fiddlers Contest and Festival in Weiser

Land regions. Idaho has three major land regions. These are, from north to south: (1) the Rocky Mountains region, (2) the Columbia Plateau, and (3) the Basin and Range Region.

The Rocky Mountains form the state's largest land region. The mountains cover the Idaho *Panhandle* (the northern tip of Idaho between Washington and Montana), the area east and north of the Columbia Plateau, and a strip along the Idaho-Wyoming border. The Rocky Mountains region has great timber supplies and the state's most important mining areas.

The Rocky Mountains region of Idaho has some of the most rugged areas in the United States. Throughout the region, steep canyons and plunging gorges have been carved by swift mountain streams. The region has several *wilderness areas* that the U.S. Forest Service has preserved without roads, logging developments, or modern improvements. The federal government owns about two-thirds of Idaho's land. The wilderness areas can be explored only on foot, on horseback, in boats, or from planes.

Many plateaus and valleys lie among the mountains and ranges of the Rocky Mountains region. These plateaus and valleys include fertile areas in western Idaho County and in parts of Clearwater and Latah counties. There, farmers raise wheat and peas.

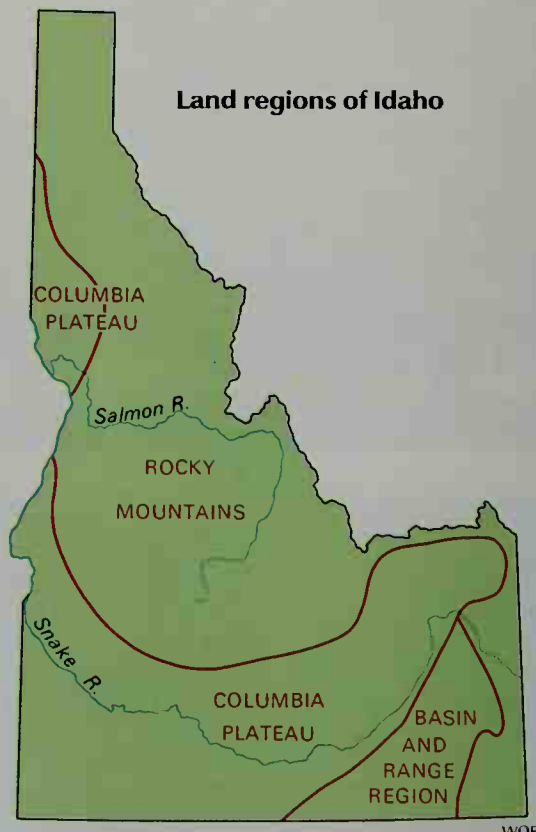
The Columbia Plateau follows the sweep of the Snake River across southern Idaho. The plateau then stretches along Idaho's western border as far north as the Panhandle, where it meets the rolling Palouse hills of the state of Washington. The Columbia Plateau includes the fertile plateau and valley areas of Lewis, Nez Perce, and western Latah counties. In the center of the plateau, the Snake River Plain covers a 20- to 40-mile (32- to 64-kilometer) strip on each side of the Snake River. The plain was built up from many lava flows that came from cracks in the earth. On the plain, farmers grow potatoes, alfalfa, beans, sugar beets, and other crops on land irrigated by well or river water. Cattle and sheep graze on the irrigated lands during the winter and on nearby mountains in summer.

Farmers in the fertile plateaus and valleys along Idaho's western border raise wheat, peas, fruits, and other crops. Dry southwestern Idaho is almost entirely a grazing and irrigated farming area.

The Basin and Range Region lies southeast of the Columbia Plateau. Part of the Rocky Mountains region lies to the east. Deep valleys and grassy plateaus lie among the region's mountains. Herds of sheep graze on the mountain slopes during the summer.

Mountains. Idaho has about 50 mountain peaks that rise above 10,000 feet (3,000 meters). Borah Peak, the state's highest mountain, towers 12,662 feet (3,859 meters) northwest of Mackay. The great Bitterroot Range lies on the Idaho-Montana border. Highways cross these mountains through passes from 5,000 to 7,000 feet (1,500 to 2,100 meters) high. The Seven Devils Mountains rise on the Oregon border.

Many other ranges also rise in Idaho. In the northern Panhandle are the Coeur d'Alene Mountains, part of the Bitterroot Range. The Coeur d'Alenes have an average height of 6,000 feet (1,800 meters). South of the Coeur d'Alenes are the Clearwater Mountains. South of these are the Salmon River Mountains, which include the spectacular Bighorn Crags. The Bighorn Crags are rough, bare mountains of granite that nature has worn into sharp spires and ridges. They are among the most rugged mountains in the entire Northwest.



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The Sawtooth Mountains rise south of the Salmon River Mountains. The Sawtooths are considered the state's most beautiful mountains, with lovely lakes and colorful meadows. The Lost River Range extends southeast from the Salmon River almost to Arco. It includes Idaho's highest peaks. The Lost River Range is a vast wilderness of snow-capped peaks. The Lemhi Range stretches east of the Lost River Range. The Snake River Range extends southeast from Rexburg along the Snake River. The Caribou Range is northeast of Grays Lake, and the Blackfoot Mountains rise northeast of Blackfoot.

Rivers, waterfalls, springs, and lakes. Idaho has several large rivers and thousands of small ones. Most of the rivers are rapid-flowing mountain streams. Many of them, such as the Bruneau River in Owyhee County, flow through deep canyons.

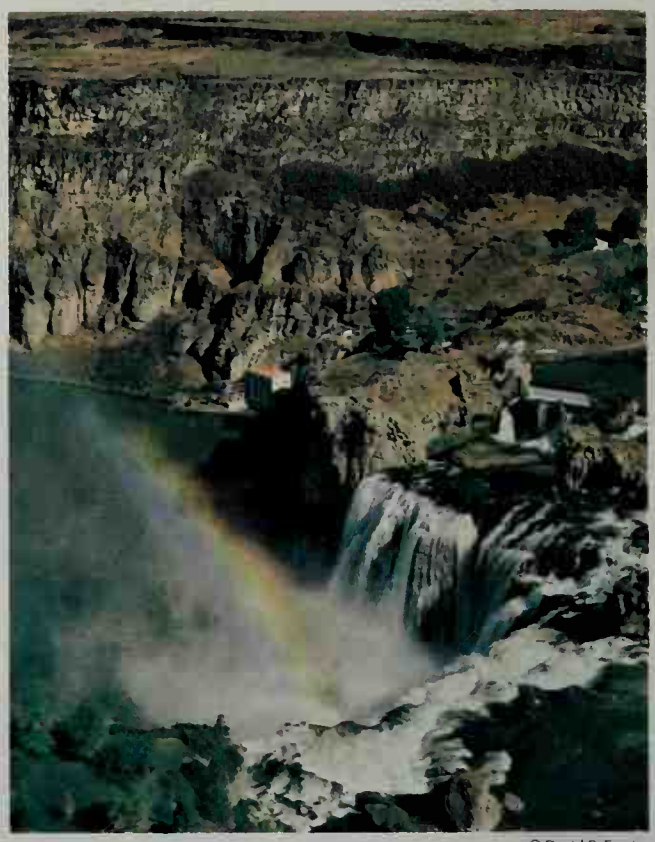
The Snake River, which is 1,038 miles (1,671 kilometers) long, flows into Idaho from its source south of Yellowstone National Park in Wyoming. The river crosses southern Idaho and forms about a third of the state's western border. In 1915, engineers completed a canal on the Columbia River so that stern-wheel vessels could travel up the Columbia and Snake rivers as far as Lewiston. This town then became a Pacific Ocean "port," although it is almost 500 miles (800 kilometers) from the ocean. To use this waterway to the sea to fullest advantage, dams have been built on the Snake River, and Lewiston has enlarged its port facilities.

The Snake River system drains most of the state. A main branch of the Snake is the Salmon River, which rises in the Sawtooth Mountains. It is called the *River of No Return,* because travelers once could not navigate upstream against its furious current and rapids. Other branches of the Snake include the Clearwater, Big Wood, Blackfoot, Boise, Payette, and Weiser rivers.

Several northern Idaho rivers drain into the Columbia River. The most important of these is the Kootenai River, which begins in Canada. The Pend Oreille River, which drains Lake Pend Oreille, also flows northwest and empties into the Columbia. The third important stream that drains westward is the Spokane River. It begins in Coeur d'Alene Lake. Several rivers flow into this lake. They include the Coeur d'Alene River, which flows west from the Coeur d'Alene Mountains, and the tree-lined, shadowy St. Joe River, which drains the Bitterroot Range.

Idaho has hundreds of large waterfalls and many small ones. Shoshone Falls, on the Snake River, plunges 212 feet (65 meters) over a horseshoe-shaped rim. Twin Falls, above Shoshone Falls on the Snake River, plunges 135 feet (41 meters). Mesa Falls, on the North Fork of the Snake River, has an upper drop of 114 feet (35 meters) and a lower drop of 65 feet (20 meters). Other waterfalls in Idaho include the Moyie Falls on the Moyie River and the Auger Falls on the Snake River.

Southern Idaho has more than a hundred mineral springs. Some are hot, and some are cold. The most famous springs include Big Creek Springs in Lemhi County, Bald Mountain Springs in Ketchum, Warm Springs in Boise, Lava Hot Springs near Pocatello, and Magic Springs near Twin Falls. The waters of Warm Springs have a temperature of 170 °F (77 °C). They are piped into some homes in Boise to provide heat. The springs in and around Soda Springs are highly charged with carbonic acid and are believed to have healthful qualities.



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Shoshone Falls, on the Snake River, plunges 212 feet (65 meters). Idaho has hundreds of large waterfalls.

Idaho has more than 2,000 well-known lakes. There are also many hundreds of lakes in remote mountain areas of the state. Lake Pend Oreille, covering 148 square miles (383 square kilometers) near the Canadian border, is Idaho's largest lake. Coeur d'Alene Lake, one of Idaho's most scenic lakes, has many resort homes and sawmills that dot its bays. Other popular recreational lakes include Alturas, Bear, Grays, Henrys, Payette, Pettit, Priest, Redfish, and Stanley.

Plant and animal life. Forests cover about 40 percent of Idaho's land area. Most of the state's trees are cone-bearing softwoods. They include Douglas-fir, Engelmann spruce, hemlock, lodgepole pine, ponderosa pine, redcedar, western larch, white fir, and white pine. Hardwood trees include birch, cottonwood, and quaking aspen.

Shrubs that grow throughout Idaho's mountains and valleys include dogwood, elderberry, huckleberry, ocean spray, purple heather, snowberry, and thimbleberry. Meadow flowers found in Idaho include the buttercup, columbine, fireweed, larkspur, lily, and violet. Syringa, the state flower, is similar to a mock orange.

Bears, cougars, deer, elk, moose, mountain goats, pronghorns, and Rocky Mountain sheep live in forests and on rangeland throughout Idaho. Smaller animals include beavers, mink, muskrats, otters, and raccoons. Bobcats and coyotes are also common. Chukar partridges, pheasants, and other game birds nest in many range and farm areas. Great numbers of salmon breed in the Salmon River. Steelhead are found in the Clearwater, Salmon, and Snake rivers. Kamloops trout are found in Lake Pend Oreille.

Climate. Most of Idaho has a milder climate than the Great Plains states in the same latitude. Winds from the Pacific Ocean bring warm sea air to the state. The high mountains east of Idaho protect it from the cold blasts from Canada and the Great Plains during the winter.

Idaho's average annual temperature is 46 °F (8 °C), but temperatures vary with the elevation. The temperature in the Sawtooth Mountains may be 40 °F (4 °C), while in nearby Boise, on the Snake River Plain, it is 80 °F (27 °C). The state has an average January temperature of 23 °F (−5 °C), and an average July temperature of 67 °F (19 °C). The state's record low of −60 °F (−51 °C) was set at Island Park Dam on Jan. 18, 1943. The record high of 118 °F (48 °C) was set at Orofino on July 28, 1934. Idaho has an annual average precipitation of 19 inches (48 centimeters). Most of it comes as snow during the winter. About 60 inches (152 centimeters) of snow falls in the state yearly.

Average monthly weather

Boise	Temperatures F		Temperatures C°		Days of rain or snow
	High	Low	High	Low	
Jan.	35	20	2	−7	12
Feb.	42	26	6	−3	11
Mar.	52	31	11	−1	10
Apr.	62	38	17	3	8
May	71	45	22	7	9
June	79	51	26	11	7
July	91	59	33	15	2
Aug.	88	57	31	14	2
Sept.	77	48	25	9	3
Oct.	65	40	18	4	7
Nov.	49	30	9	−1	10
Dec.	38	24	3	−4	12

Lewiston	Temperatures F		Temperatures C°		Days of rain or snow
	High	Low	High	Low	
Jan.	37	24	3	−4	13
Feb.	43	29	6	−2	9
Mar.	53	35	12	2	10
Apr.	62	41	17	5	8
May	71	47	22	8	10
June	78	54	26	12	10
July	90	60	32	16	4
Aug.	89	58	32	14	4
Sept.	77	49	25	9	4
Oct.	63	40	17	4	9
Nov.	48	33	9	1	10
Dec.	40	28	4	−2	11

Average January temperatures

Idaho has wide variations in temperature during the wintertime. The northeastern area has the coldest weather.

Average July temperatures

The state has mild summers. The southern and western regions have the highest temperatures, the far north the lowest.

Average yearly precipitation

Precipitation in Idaho varies widely. The northern part receives most of the precipitation, mainly as winter snow.

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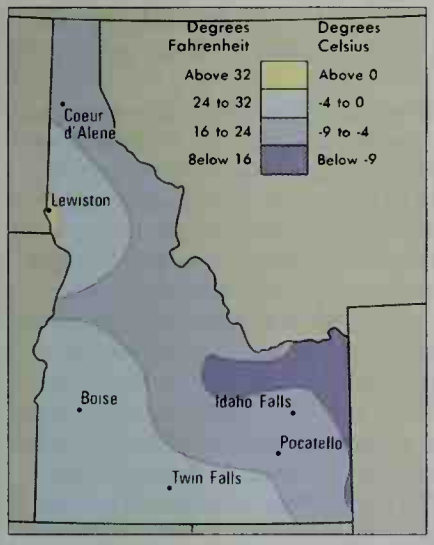

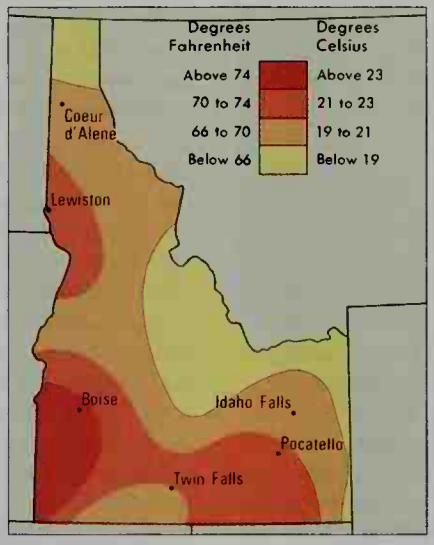

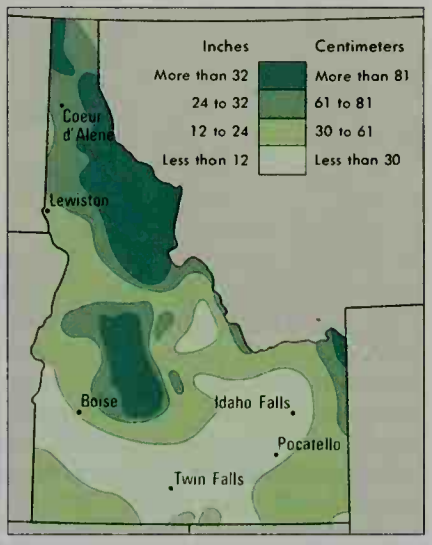

Economy

Idaho's economy relies heavily on resources found within the state. Timber from Idaho's rugged mountains and farm products from its fertile plateaus provide raw materials for manufacturing. The state's rivers provide low-cost hydroelectric power. Rich deposits of metal ores lie in several parts of the state.

Idaho's natural beauty attracts many tourists, who travel to the state for skiing, camping, fishing, and whitewater rafting. Tourism is an important source of income for the state's service industries, which include real estate, recreation, and retail trade. Taken together, service industries provide about two-thirds of Idaho's *gross state product*—the total value of goods and services produced within the state in a year. But manufacturing is the state's single most important economic activity. It accounts for nearly a fourth of the gross state product.

Natural resources of Idaho include fertile soils, vast mineral deposits, plentiful water, and dense forests.

Soil is one of Idaho's greatest treasures because it is the basis of agriculture. Idaho has several types of soil. Soils developed on glacier-deposited material support the northernmost forests. The prairie and plains soils were developed on broken-up lava and windblown material called *loess. Alluvial soil,* made up of material deposited by streams, covers some mountain valleys.

Minerals. Valuable mineral deposits have been found in all of Idaho's 44 counties. The state's richest mineral resources are silver, phosphate rock, and molybdenum. Some of the largest mineral deposits lie in the northern Panhandle. All of Idaho's phosphate rock comes from the southeastern part of the state. Copper, lead, silver, and zinc deposits lie in Shoshone County. Deposits of antimony, cadmium, clay, cobalt, garnet, gold, lead, limestone, sand and gravel, thorium, tungsten, uranium, vanadium, and zinc are found in the state.

Water is often said to be Idaho's most valuable min-

Production and workers by economic activities

Economic activities	Percent of GSP* produced	Employed workers: Number of people	Employed workers: Percent of total
Manufacturing	19	82,900	11
Wholesale & retail trade	17	164,300	22
Community, business, & personal services	16	190,100	26
Government	14	109,400	15
Finance, insurance, & real estate	13	45,800	6
Transportation, communication, & utilities	9	31,700	4
Construction	6	51,000	7
Agriculture	5	58,000	8
Mining	1	4,000	1
Total	100	737,200	100

*GSP = gross state product, the total value of goods and services produced in a year. Figures are for 1998.
Sources: *World Book* estimates based on data from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

eral. Five large river systems cross Idaho, and one large river, the Salmon, is the longest river that lies entirely within the boundaries of a state. The Clearwater River also lies entirely within Idaho. In addition, Idaho has enormous underground water resources.

Forests cover about 40 percent of Idaho's land area. The state once had some of the nation's largest white-pine forests, but blister rust, a tree fungus, reduced the forests to about 10 percent of their former size. Most of Idaho's trees are cone-bearing softwoods, especially Douglas-fir, Engelmann spruce, hemlock, lodgepole pine, ponderosa pine, redcedar, western larch, white fir, and white pine. *Deciduous trees* (trees that shed their leaves annually) grow throughout Idaho. These trees include birch, cottonwood, and quaking aspen.

Service industries make up the largest portion of the gross state product of Idaho. Most of the service industries are centered in Boise and other urban areas.

Community, business, and personal services are Idaho's leading service industry group in terms of the gross state product. The group includes such businesses as private health care, hotels and ski resorts, and engineering and law firms.

Wholesale and retail trade is Idaho's second-ranking service industry. The state's important wholesale products include groceries, petroleum, and wood products. Major retail businesses include automobile dealerships, food stores, and restaurants. Albertson's, the nation's largest food store chain, is headquartered in Boise.

Government is the third-ranking service industry in Idaho. Government services include public schools and hospitals, and Indian reservations. The federal government owns much of the land in the mountainous areas of the state and controls logging and mining operations there. The U.S. Department of Energy's Idaho National Engineering and Environmental Laboratory near Idaho Falls is a major employer in the state.

Finance, insurance, and real estate form Idaho's fourth-ranking service industry. Boise is Idaho's chief financial center. The largest banks in the state are U.S. Bank and Wells Fargo Bank. The real estate business is important throughout the state's urban areas.

Transportation, communication, and utilities rank fifth among service industries in Idaho. Several shipping firms are based at the port of Lewiston. Many trucking firms operate in the state, and railroads employ many people. Qwest Communications is the state's major communications company, and Idaho Power is the largest utility company. For more information on these industries, see the headings *Transportation* and *Communication* in this section.

Manufacturing. Goods manufactured in Idaho have a *value added by manufacture* of about $7 billion. This figure represents the increase in value of raw materials after they become finished products.

Computer and electronic equipment is Idaho's leading manufactured product in terms of value added by manufacture. Computer microchips are the chief type of electronic equipment made in the state. Micron Technology, a leading microchip maker, is based in Boise.

Food processing ranks second among Idaho's manufacturing activities. Most of the food-processing plants are in the southern part of the state. Idaho has about 20 potato-processing plants. Other plants in the state include beet-sugar refineries, canning and freezing companies, dairies, and plants that process meat, poultry, and wheat.

Idaho's other leading manufactured products include chemicals, fabricated metal products, and lumber and wood products. Industrial and agricultural chemicals are the most important chemical products. Sheet metal, structural metals, and ammunition are Idaho's most valuable fabricated metal products. Boise-Cascade, a major U.S. wood-products company, is based in Boise.

Agriculture. Idaho has about 24,500 farms and ranches. They cover about a fourth of the state. Most of Idaho's cropland is irrigated.

Crops are the main source of Idaho's agricultural income. Potatoes rank as the state's leading crop, followed by hay and wheat. Farmers grow potatoes and wheat mainly in the irrigated Snake River area. Hay is grown primarily on the plains of eastern Idaho. Idaho grows

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Potatoes are Idaho's leading crop. Idaho harvests more potatoes than any other state. The major agricultural region is located in southern Idaho in the Snake River area.

more potatoes than any other state. It also ranks among the leaders in barley production.

Sugar beets, like potatoes and wheat, are grown chiefly in the Snake River area. Idaho is a leading sugar beet producer. Important grass and seed crops include alfalfa seed, bluegrass seed, hops, and mint. Fruit trees and vegetables grow mainly in southwestern Idaho.

Beef cattle are Idaho's most valuable farm product. Most of the state's cattle ranches lie on the central range and the plains of southern Idaho. Milk is a valuable livestock product. Dairy farms operate along the Snake River Valley in southern Idaho.

Sheep graze in the mountains in summer and in the valleys and on the plains in winter. Idaho ranks as an important producer of lambs and wool.

Mining. Silver, phosphate rock, and gold provide most of the income that Idaho receives from mining. Shoshone County in northern Idaho is one of the nation's chief silver-mining areas. Phosphate rock, which is used to make fertilizer, is mined in the southeastern part of the state. The state's largest gold mine is near Yellow Pine in central Idaho. Other important mined products include clays, copper, crushed stone, garnet, molybdenum, sand and gravel, and vanadium.

Electric power. Nearly all of Idaho's electric power comes from hydroelectric plants. The state has about 35 hydroelectric plants. Sites of Idaho's federal hydroelectric plants include Brownlee Dam, Cabinet Gorge Dam, Dworshak Dam, and Palisades Dam.

Transportation. The Oregon Trail, one of the great early overland routes in the United States, wound through the wild Idaho frontier (see **Oregon Trail** [map]). The first railroad crossed the Idaho-Utah border in 1874.

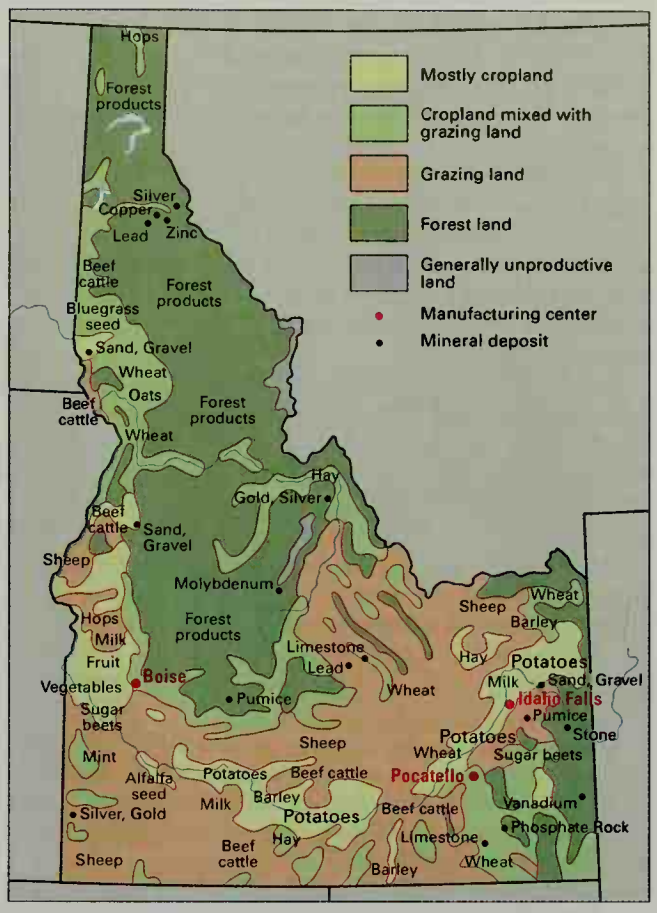
Today, Idaho has one of the nation's finest transportation networks. Modern highways connect the state's major urban centers with other states. The Snake River provides access to the Pacific Ocean. Two major railroads supply freight service, and passenger trains serve five cities. Boise has a major airport.

The main road across southern Idaho is Interstate 84. It follows the general route of the old Oregon Trail. The main road across northern Idaho is Interstate 90. A main north-south road, U.S. Highway 95, winds through western Idaho into Canada. The state has about 60,000 miles (96,000 kilometers) of roads and highways.

Lewiston, often called the *Seaport of Idaho,* is a river port. Dams on the Columbia and Snake rivers permit barges and tugs to haul farm and forest products between the city and the Pacific Coast.

Economy of Idaho

This map shows the economic uses of land in Idaho and where the leading farm, mineral, and forest products are produced. Major manufacturing centers are shown in red.



WORLD BOOK map

Communication. The first newspaper in Idaho was the *Golden Age,* published at Lewiston from August 1862 to January 1865. Today, Idaho has about 65 newspapers, 10 of which are dailies. Daily newspapers with the largest circulation include the *Idaho Statesman* of Boise, the *Post-Register* of Idaho Falls, the *Tribune* of Lewiston and the *Times-News* of Twin Falls.

Idaho's first radio station, KFAU (now KIDO), began commercial broadcasting in 1922 at Boise. The state's first television station, KIDO (now KTVB), began operating at Boise in July 1953. Idaho has about 85 radio stations, 12 TV stations, and 15 cable TV systems. Internet providers serve many communities.

Government

Constitution. Idaho is still governed under its original state Constitution. The Constitution was adopted in 1889, 11 months before the Idaho Territory became a state. Since then, the Constitution has been amended more than 100 times.

Amendments to the Constitution are proposed either by a two-thirds vote of both houses of the state Legislature or by a convention called by the Legislature for that purpose. To be adopted, an amendment must be approved by a majority of the people voting on the amendment.

Executive. Voters elect the governor to a four-year term. The governor does not have the power to appoint the top state officials, which include the lieutenant governor, secretary of state, auditor, treasurer, superintendent of public instruction, and attorney general. Voters elect these officials to four-year terms.

Legislature of Idaho consists of a 35-member Senate and a 70-member House of Representatives. Idaho has 35 legislative districts. Voters in each district elect two representatives and one senator. Senators and representatives serve two-year terms. The state Legislature

meets every year. Regular sessions of the Legislature begin the Monday on or nearest January 9. They usually last 90 days, but there is no time limit. The governor may call special sessions of the Legislature. Such legislative sessions are limited to 20 days.

Courts. The highest court in Idaho is the state Supreme Court. It has a chief justice and four associate justices. The justices serve six-year terms. The voters elect two justices in one year, two others two years later, and one justice two years after that. The Supreme Court justices elect one of their members to serve as chief justice for a four-year term.

After the Supreme Court, Idaho's next highest court is the Court of Appeals. It has three judges elected to six-year terms. Voters in seven judicial districts elect district court judges to four-year terms. Each county has at least one magistrate.

Local government. Idaho has 44 counties, each governed by three commissioners. Two of the commissioners are elected to two-year terms. The third commissioner is elected to a four-year term. One of the commissioners is selected by the other two to serve as head of the commission.

Other county officials include the sheriff, assessor, prosecuting attorney, coroner, treasurer (who is also tax collector), and clerk of the district court (who also serves as auditor and recorder). All these officials are elected to four-year terms. Almost all the cities of Idaho have a mayor-council form of government.

Revenue. Taxes and licenses provide more than 50 percent of the state government's *general revenue* (income). Most of the rest comes from federal grants and other United States government programs. The major sources of tax revenue in Idaho are a personal income tax and a general sales tax. Other significant sources of the state's revenue include motor fuel taxes and corporate income taxes.

Politics. In elections for governor, Idahoans have elected more Republicans than Democrats. Idahoans have also sent more Republicans than Democrats to the United States Senate and the United States House of Representatives.

Since 1952, Idahoans have voted for the Republican candidate in every presidential election but one. The exception came in 1964, when Idaho supported Democrat Lyndon B. Johnson. For the state's voting record in presidential elections since 1892, see **Electoral College** (table).

The governors of Idaho

	Party	Term
George L. Shoup	Republican	1890
N. B. Willey	Republican	1891-1893
William J. McConnell	Republican	1893-1897
Frank Steunenberg	Democratic	1897-1901
Frank W. Hunt	Democratic	1901-1903
John T. Morrison	Republican	1903-1905
Frank R. Gooding	Republican	1905-1909
James H. Brady	Republican	1909-1911
James H. Hawley	Democratic	1911-1913
John M. Haines	Republican	1913-1915
Moses Alexander	Democratic	1915-1919
D. W. Davis	Republican	1919-1923
Charles C. Moore	Republican	1923-1927
H. C. Baldridge	Republican	1927-1931
C. Ben Ross	Democratic	1931-1937
Barzilla W. Clark	Democratic	1937-1939
C. A. Bottolfsen	Republican	1939-1941
Chase A. Clark	Democratic	1941-1943
C. A. Bottolfsen	Republican	1943-1945
Charles C. Gossett	Democratic	1945
Arnold Williams	Democratic	1945-1947
C. A. Robins	Republican	1947-1951
Len B. Jordan	Republican	1951-1955
Robert E. Smylie	Republican	1955-1967
Don Samuelson	Republican	1967-1971
Cecil D. Andrus	Democratic	1971-1977
John V. Evans	Democratic	1977-1987
Cecil D. Andrus	Democratic	1987-1995
Phil Batt	Republican	1995-1999
Dirk Kempthorne	Republican	1999-

History

Indian days. Indians lived in the Idaho region more than 10,000 years ago. Remains of early Indian culture have been found in hundreds of locations, and many present-day place names have Indian origins. The tribes that lived in Idaho included the Nez Perce, Coeur d'Alene, Pend d'Oreille, Shoshone, Kutenai, Paiute, and Bannock. The two largest tribes were the Nez Perce and the Shoshone.

Exploration and early settlement. In 1805, the famous explorers Meriwether Lewis and William Clark became the first white men to explore the Idaho region. They crossed the great Bitterroot Range. Then, aided by the Shoshone and Nez Perce, the explorers built canoes and floated down the Clearwater and Snake rivers to the Columbia River.

In 1809, David Thompson, a Canadian explorer, built a fur-trading post on the shores of Lake Pend Oreille. In 1834, two more posts were built. They were Fort Hall, founded by the American Nathaniel Wyeth, and Fort Boise, founded by Thomas McKay of the British Hudson's Bay Company. In 1836, Henry and Eliza Spalding, two Presbyterian missionaries, traveled to the Idaho region. That year, they established the Lapwai Mission Station near present-day Lewiston. Eliza Spalding was one of the first white women to journey overland to the Northwest.

A group of Mormons began farming in eastern Idaho in 1855. They built Fort Lemhi and started Idaho's first irrigation projects. But they did not stay in the area. In 1860, another band of Mormons founded Idaho's first permanent settlement, at Franklin.

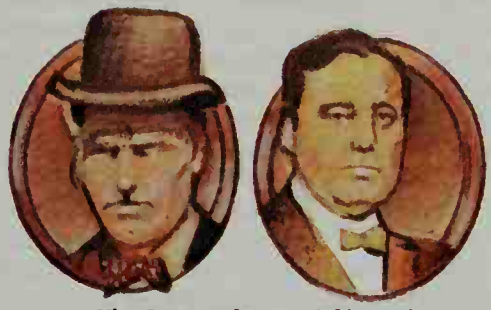
In 1860, E. D. Pierce, a prospector, found gold on Orofino Creek. In 1862, George Grimes discovered gold in the Boise Basin. News of these and other rich strikes spread rapidly, and gold seekers poured into the Idaho region. Towns grew up almost overnight near the discoveries.

Territorial development. The Idaho Territory was established March 4, 1863, with Lewiston as the capital. The territory included present-day Idaho, Montana, and

Historic Idaho

Idaho's first gold was discovered by prospector E. D. Pierce on Orofino Creek in 1860. George Grimes found gold in the Boise Basin in 1862.

Chief Joseph and the Nez Perce Indians defeated U.S. troops at White Bird Canyon in June 1877. The Indians surrendered four months later near the Canadian border.



The Steunenberg Trial brought worldwide attention to Idaho in 1907. William D. "Big Bill" Haywood, *left,* was acquitted of involvement in the 1905 murder of former Idaho governor Frank Steunenberg. U.S. Senator William Borah, *right,* the lawyer for the state, gained national fame during the trial.

Lewis and Clark reached Idaho in 1805 after crossing the Bitterroot Range. They camped near the site where Lewiston was founded in 1861.

Mormons began farming in eastern Idaho in 1855, but they did not stay. In 1860, another band of Mormons founded Franklin, Idaho's first permanent settlement.

WORLD BOOK illustrations by Kevin Chadwick

Important dates in Idaho

1805 Lewis and Clark passed through the Idaho region on their way to the Pacific Coast.
1809 David Thompson built the first fur-trading post in Idaho.
1834 Fort Boise and Fort Hall were established.
1860 Franklin, Idaho's first permanent settlement, was founded. Gold was discovered on Orofino Creek.
1862 Gold was discovered in the Boise Basin.
1863 Congress established the Idaho Territory.
1874 Utah Northern Railroad entered Idaho Territory at Franklin.
1877 U.S. troops defeated the Nez Perce Indians in the Nez Perce War.
1890 Idaho entered the Union as the 43rd state on July 3.
1892 and 1899 Violence broke out between union miners and mine owners.
1905 Former Idaho Governor Frank Steunenberg was murdered. The murder trial, held in 1907, attracted international attention.
1951 Electricity was generated from nuclear energy for the first time at a reactor testing station near Idaho Falls.
1959 Engineers completed Brownlee Dam, the first of three large hydroelectric dams on the Snake River built by a private utility. Oxbow Dam was completed in 1961. Hells Canyon Dam was completed in 1968.
1972 Ninety-one miners died in a fire at the Sunshine silver mine in Shoshone County.
1990 Idaho celebrated the centennial of its statehood.

almost all of Wyoming. Montana became a separate territory in 1864, and Wyoming was made a territory in 1868. In 1864, Boise became the capital of the Idaho Territory.

The development of railroads in Idaho brought a wave of settlers to the territory. Mormons brought the Utah Northern Railroad into Idaho at Franklin in 1874. Silver-lead mines in northern Idaho stimulated railroad construction in that region. By 1884, the Oregon Short Line Railroad linked mines at Hailey and the Big Wood River with Oregon.

Indian fighting. As white settlements expanded in the Northwest, conflicts with Indians increased. In 1877, the U.S. Army, under pressure from the settlers, tried to force the Nez Perce Indians to move from Oregon to the Lapwai Reservation in Idaho. The Indians resisted. On June 17, 1877, they crushed the troops in a battle at White Bird Canyon in north-central Idaho. However, the Nez Perce were soon forced to retreat before larger numbers of soldiers. In October, near the Canadian border, they surrendered.

In 1878, the Bannock Indians rebelled because of lack of food and other problems on their reservation. They had also been deprived of their traditional hunting grounds. The Indians tried to dig camas roots on the prairie in order to find food, but settlers objected because their cattle grazed there. During the rebellion, Chief Buffalo Horn was killed. After the chief's death, the Bannock Indians split into several groups and were defeated.

Early statehood. In 1889, the Idaho Territory adopted a constitution. Idaho entered the Union as the 43rd state on July 3, 1890. George L. Shoup, a Republican, became the first state governor.

During the 1890's, disputes arose between miners and mine owners. The quarrels often flared into bloody violence. Battles also broke out between nonunion miners and members of a labor union called the Western Federation of Miners. This organization was the chief union in the Industrial Workers of the World (see **Industrial Workers of the World**). In 1892, the Coeur d'Alene region became the scene of dynamiting and shooting as union miners fought nonunion men and mine owners in a violent strike. Violence and a second strike broke out again in 1899. Governor Frank Steunenberg declared martial law and called in federal troops, who eventually broke the strike.

Steunenberg, no longer governor, was murdered in 1905. He was killed when he opened his front gate and set off a bomb attached to the gate. Harry Orchard, who was a member of the Western Federation of Miners, confessed to the crime and said three union officials were also involved. The murder trial, held in 1907, attracted worldwide attention. It brought national fame to United States Senator William E. Borah, a lawyer for the state. The famous defense attorney Clarence Darrow represented the accused union leaders, headed by William D. "Big Bill" Haywood. Haywood and another of the officials were freed, and charges were dropped against the third official. Orchard received a sentence of life imprisonment.

In the early 1900's, irrigation projects brought water to Idaho's desert lands, and agriculture expanded in the state. In 1905, the Twin Falls Land and Water Company, organized by Ira B. Perrine, diverted water from the Snake River to irrigate 60,000 acres (24,000 hectares) of land. In 1906, the U.S. Bureau of Reclamation completed the Minidoka Dam on the Snake River. This irrigation system opened up more than 100,000 acres (40,000 hectares) of land to farmers.

World War I and after. World War I brought a boom to Idaho's agricultural economy after the United States entered the war in 1917. Wartime food shortages created farm prosperity. Wartime inflation also boosted prices of land and operating costs. However, when the war ended, Idaho's prosperity collapsed.

In the 1920's, Idaho's farmers, like many farmers in the United States, were hard pressed. Idaho's economy worsened during the Great Depression of the 1930's, and many banks in the state went bankrupt. The federal government set up agencies to help farmers and other Idahoans. The Civilian Conservation Corps (CCC), an important federal agency during the depression, did conservation work in Idaho's forests.

Modern highway construction also progressed during the 1930's in Idaho. By 1938, a paved highway finally connected the northern and southern sections of the state.

World War II. During World War II (1939-1945), many Idahoans worked in factories that made airplanes, arms, and other military supplies. Idaho supplied large amounts of food to the armed services. Soon after the United States entered the war, Japanese Americans living on the West Coast and in southern Arizona were moved to relocation camps. Camp Minidoka, near Twin Falls, received Japanese Americans from the areas of Oregon and Washington. These people worked on potato and sugar beet farms, filling the shortage of farmworkers caused by the war.

Postwar changes. After the war, Idaho's economy began to change from one based chiefly on agriculture to one that included food processing and manufacturing. A housing boom following the war spurred Idaho's lumber industry. Materials that were once considered to be waste products were used to produce paper containers, plywood, and wood pulp.

Idaho's population began to shift from rural to urban areas. In 1940, only about a third of the people lived in cities. But Idaho's farms, like those in many other states, began to decrease in number and increase in size. The use of farm machinery grew, and fewer farmworkers were needed. People began to move to urban areas and take jobs in manufacturing. By 1960, about half of Idaho's population lived in cities or towns.

In 1949, the Atomic Energy Commission (AEC) built the National Reactor Testing Station (now Idaho National Engineering and Environmental Laboratory) near Idaho Falls. Scientists at the station had the job of making, testing, and operating nuclear reactors and related devices. In December 1951, at the testing station, electricity was generated from nuclear energy for the first time in history. The scientists also built a model reactor for the first nuclear submarine, the U.S.S. *Nautilus*. In 1955, Arco became the first community in the world to receive its entire power supply from nuclear energy. The station supplied the town's power for one hour on July 17. By the mid-1960's, the Idaho Falls station had one of the world's largest assortments of nuclear reactors.

During the 1950's, Idaho's expanding agriculture and industry made increasing demands for more hydroelectric power. In 1955, the Idaho Power Company began to build a series of three dams on the Snake River. The company completed its Brownlee Dam in 1959, its Oxbow Dam in 1961, and its Hells Canyon Dam in 1968.

The late 1900's. During the 1970's, the state suffered two of the worst disasters in its history. In 1972, an underground fire in the Sunshine silver mine resulted in 91 deaths. In 1976, the Teton Dam on the Teton River collapsed. Billions of gallons of water swept through Sugar City, Rexburg, and several other farming communities in the upper Snake River area. As a result, flooding caused at least 11 deaths and damaged about $400 million worth of property.

In the 1980's and 1990's, Idaho's mining and logging industries declined in importance. Low metal prices and decreasing ore reserves caused several of the state's silver and molybdenum mines to close. Also in the 1980's and 1990's, disputes took place between Idahoans who wanted to conserve the state's natural environment and those who wanted to encourage the economic development of its natural resources. Using its natural resources wisely continued to be a challenge for the state.

During the late 1900's, Idaho's population grew rapidly. From 1970 to 1980, the population increased by 32 percent, putting a strain on schools, roads, and sewage systems. From 1980 to 1990, the rate of population growth slowed to only 7 percent. But from 1990 to 2000, the rate of increase was 28.5 percent.

Recent developments. Today, agriculture remains vital to Idaho's economy, but other economic activities have grown in the state. In the last half of the 1900's, many small industries moved to Idaho. Large construction, food processing, and lumber companies established headquarters in Boise, and a major computer firm set up operations there.

The tourist industry continues to contribute to the economy. Sun Valley, a famous vacation area, attracts large numbers of visitors. New vacation sites developed in other parts of Idaho have experienced rapid growth.

Ronald L. Hatzenbuehler and Harley Johansen

Study aids

Related articles in *World Book* include:

Biographies

Borah, William E.
Borglum, Gutzon
Joseph, Chief
Pound, Ezra
Sacagawea
Shoup, George L.

Cities

Boise
Idaho Falls
Pocatello
Sun Valley

History

Bannock Indians
Indian wars (The Nez Perce War)
Kutenai Indians
Lewis and Clark Expedition
Nez Perce Indians
Paiute Indians
Shoshone Indians
Western frontier life in America

Physical features

Coeur d'Alene Mountains
Great Basin
Rocky Mountains
Snake River
Wasatch Range
Yellowstone National Park

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VI. History

Questions

Who were the first white people to explore the region that is now Idaho?
Why is irrigation important to Idaho?
What is the deepest canyon in the United States?
What is Idaho's most famous crop?
Why did the Bannock Indians rebel in the 1870's?
When did Idaho adopt its Constitution?
What is Idaho's leading manufacturing activity?
What town in Idaho is a Pacific Ocean "port"?
What is Idaho's chief source of power?
How did Idaho's economy change after World War II ended?

Additional resources

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Idaho, University of, is a coeducational land grant school in Moscow, Idaho. It has colleges of agriculture, architecture, business, education, engineering, forestry, law, letters and science, and mines, and a graduate school. It grants bachelor's, master's, and doctor's degrees. The university conducts a joint graduate program in atomic engineering with the Idaho National Engineering and Environmental Laboratory near Idaho Falls, Idaho, and the Hanford Graduate Center in Richland, Washington. Staff members at these two installations teach the courses offered in this special program.

The University of Idaho library maintains a special collection of books and documents on the Pacific Northwest. It also has about 65,000 maps. The university was founded in 1889. Critically reviewed by the University of Idaho

Idaho Falls (pop. 50,730) is one of the largest cities in Idaho. Idaho Falls lies on the Snake River in the southeastern part of the state (see **Idaho** [political map]). The city is a retail and service center for the region, and it serves as a food-processing center for farms in the Snake River Valley. The area has large potato-processing plants and plants for producing barley malt.

In 1865, a freight hauler named James Madison Taylor built a toll bridge in what is now the Idaho Falls area. Miners used the bridge to reach nearby gold deposits, and merchants built stores to serve the miners. In 1891, the people of the settlement changed its name from Eagle Rock to Idaho Falls because the rapids of the Snake River resembled falls. During the early 1900's, the construction of flour mills and sugar factories helped the population of Idaho Falls grow.

In 1949, the Atomic Energy Commission built a reactor testing station 30 miles (48 kilometers) west of Idaho Falls. The station, now known as the Idaho National Engineering and Environmental Laboratory and operated by EG&G Idaho, Inc., is the city's chief employer (see **Idaho National Engineering and Environmental Laboratory**). Dean Miller

Idaho National Engineering and Environmental Laboratory, near Idaho Falls, Idaho, is the leading center in the United States for testing the safety of nuclear reactors. It is also involved in the recovery and *reprocessing* (recycling) of nuclear fuel used in U.S. Navy ships and in the storage and disposal of nuclear waste. The laboratory also does research on nonnuclear forms of energy. A branch of Argonne National Laboratory called Argonne-West is located there (see **Argonne National Laboratory**).

EG&G Idaho, Inc., operates the Idaho National Engineering and Environmental Laboratory under contract with the U.S. Department of Energy. The facility was originally named the National Reactor Testing Station. It was established in 1949 to build and test nuclear reactors and related equipment. The first *pressurized water reactor* and *boiling water reactor* were built there in the 1950's. In 1955, one of the boiling water reactors became the first nuclear reactor to provide energy to light an American town—Arco, Idaho. Toni Grayson Joseph

See also National laboratory.

Idaho State University is a state-supported, coeducational liberal arts school in Pocatello, Idaho. It has colleges of arts and sciences, business, education, engineering, health-related professions, and pharmacy; a graduate school; and a school of applied technology. It grants associate, bachelor's, master's, and doctor's degrees. Idaho State University was founded in 1901 as the Academy of Idaho. The school became a campus of the University of Idaho in 1927. The Idaho legislature renamed the school Idaho State College in 1947. The university took its present name in 1963. Critically reviewed by Idaho State University

Idealism, in philosophy, is a *metaphysical* theory—that is, a theory about the nature of reality. According to metaphysical idealism, the external world consists of ideas that, being ideas, can exist only in the mind. According to this view, reality is thus mental or spiritual. The opposing philosophical view, called *materialism,* maintains that reality consists of physical objects alone and that it is governed by purely physical forces.

In the early 1700's, George Berkeley, an Anglican bishop and philosopher, claimed that the physical world is just a set of ideas or appearances in the minds of God and individual souls. For Berkeley, the physical world had no independent existence apart from the mind.

Initially, idealism strikes most people as absurd. The theory appears to deny what we all know, that the world of galaxies, mountains, trees, and skyscrapers exists. One story tells that Samuel Johnson, a famous English writer of the 1700's, kicked a stone and uttered the words, "Thus I refute Berkeley!"

Most idealists would regard Johnson's comment as irrelevant. Berkeley claimed that he did not deny that the physical world exists or is real. His idealism is a theory about the *nature* of the physical world, not its *existence.* Berkeley claimed that physical objects are real but that they could not exist without God and other spirits. For Berkeley, in order for something to exist, it had to be perceived by some spirit.

In the late 1700's and 1800's, the German philosophers Immanuel Kant and G. W. F. Hegel and other influential idealists tried to show that reality is spiritual or is dependent on minds without denying the reality of the physical world. In fact, idealists often argue that a reality that is totally separate from the mind could not possibly be known. From the idealist perspective, it is *realism*—the belief in the existence of physical things that are independent of the mind—that leads to skepticism and doubt about the reality of the world. If the world had a nature and existence separate from our minds, it would seem to be difficult or impossible to know it. According to the idealists, only idealism, by bringing the world into the mind, makes reality knowable.

Modern thinkers continue to debate about the nature of reality. Metaphysical realists believe that reality is objective—that is, its existence and nature are independent of our minds. However, most metaphysical realists would agree that we can only know the world in the form that it appears to us, and that the way the world appears to us depends on our minds, senses, and cultural traditions. Idealists would argue that both of these views cannot be true. They resolve the conflict between these views by rejecting the idea that reality is independent of our minds. Stephen Nathanson

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Philosophy (Modern philosophy)
Royce, Josiah
Transcendentalism

Identical twins. See Multiple birth.

Ideograph, also called *ideogram.* See Alphabet (The earliest writing); Hieroglyphics; Pictograph; Writing.

Ideology, *EYE dee AHL uh jee* or *IHD ee AHL uh jee,* is a system of thought based on related assumptions, beliefs, and explanations of social movements or policies. Its content may be economic, political, philosophical, or religious. Some ideologies, such as communism and socialism, refer to economic and political systems. Most "isms" are ideologies. Other ideologies are capitalism, democracy, fascism, feminism, Protestantism, racism, Roman Catholicism, and totalitarianism.

Ideologies do not rely equally on factual information in supporting their beliefs. People who accept an entire thought system usually reject all other systems concerned with the same content. To such people, only conclusions based on their ideology seem logical and correct. Thus, people strongly committed to an ideology have difficulty understanding and communicating with supporters of a conflicting ideology.

Conflicting ideologies held by various nations, social classes, or religious groups have led to the world's greatest and most dangerous controversies. For example, World War II (1939-1945) was largely a struggle between democratic and totalitarian nations. Jennie Keith

Iditarod, *eye DIHT uh rahd,* is the world's most famous sled-dog race. The annual race starts on the first Saturday of March in Anchorage, Alaska, and ends in Nome, Alaska. It crosses the Alaska and Kuskokwim mountain ranges, heading northwest across the state and then north along the Bering Sea coast to Nome. The race follows a northern route in even years and a southern route in odd-numbered years.

The Iditarod requires enormous endurance, both from the sled driver, known as the *musher,* and the dogs. The race covers about 1,100 miles (1,770 kilometers), much of the distance icy, snowy trails. The Iditarod typically takes about 9 to 12 days to run but may last 15 days or longer. Mushers and their dogs may train all year for the race. Both men and women compete.

As many as 18 dogs pull each sled. The average is 15. The dogs, normally Siberian or Alaskan huskies, are selected for speed, endurance, and courage. The sled is extremely light, but it must be strong enough to carry the weight of the musher, equipment and provisions for the race, and sick or exhausted dogs.

The current Iditarod format originated in 1973, developing from shorter sled-dog races in 1967 and 1969. It is held on the Iditarod Trail, a dog sled mail route first used in 1910. The race also commemorates an emergency mission by dog sled to get medical supplies to Nome during a diphtheria outbreak in 1925.

Dave Nightingale

Idolatry, *eye DAHL uh tree,* is the worship of a statue or image of a god or spirit. The term also refers to the worship of false gods. A number of religions regard the practice of other faiths as idolatry.

Christians, Jews, and Muslims consider the worship of images a sin. Since ancient times, the prohibition of idolatry has resulted in strict limits on the use of lifelike images in Islamic and Jewish art. However, the early Christians used paintings, statues, and other art to depict sacred figures and stories from the Bible. In Eastern Europe and the Near East, worshipers gave special reverence to *icons* (images of Jesus Christ or the saints).

Christians known as *iconoclasts* opposed the use of icons because they considered it idolatry. But other Christians argued that icons were just symbols to help worshipers think of God. A dispute called the *iconoclastic controversy* raged between the two sides during the A.D. 700's and early 800's. The iconoclasts destroyed pictures and statues in many churches. A similar disagreement over the use of images broke out between Protestants and Roman Catholics during the 1500's. Many old churches in the United Kingdom and other countries still have statues that were damaged by Protestants.

During the 1200's, Christian missionaries from Europe traveled as far as China, and by the 1500's, they had also reached Africa and the Americas. The missionaries described the religions of these lands as idolatry, but few of the peoples they encountered actually worshiped idols. Many of the so-called idol worshipers used statues or other symbols of their gods much as Christians used religious art. Other peoples who seemed to worship a nonliving object believed that a god or spirit dwelled in it.

Today, the scholars who study ancient and modern religions do not use the term *idolatry.* But the word often means giving someone or something other than God the devotion that should belong only to Him. For example, an excessive love of money is sometimes called idolatry. Erika Bourguignon

See also Fetish; Icon; Iconoclast; Moses (The covenant with God).

Idyl, *EYE duhl,* also spelled *idyll,* is a kind of pastoral poem developed by the ancient Greeks. The name comes from the Greek word for *little picture.* Usually of moderate length, idyls present peaceful rural scenes. They treat such themes as youth, poetry, and love. The Greek idyls of Theocritus and the Roman *Eclogues* of Virgil are examples of classical idyls. In their imitation of classical poets, many English poets of the late 1500's and the 1600's wrote pastoral poems. One of the finest idyls written at this time is John Milton's *Lycidas.* It is an elegy upon the death of a friend, Edward King. Paul B. Diehl

See also Theocritus; Virgil.

IEA. See International Energy Agency.

Ieyasu, Tokugawa. See Tokugawa Ieyasu.

Ife, *EE fay,* was an important black African city-state founded around 950 by the Yoruba people of West Africa. Ife reached the height of its power about 1300. Scholars believe Ife prospered by controlling much of the slave, gold, and ivory trade along the lower Niger River. In the early 1500's, Ife began to decline, as trade shifted from inland routes to the coast. Ife culture is known for its outstanding sculptures of *terra cotta* (baked clay) and brass, most of which date from the 1100's to the 1400's.

Today, Ife is a city in southwestern Nigeria. The Yoruba view the city as a holy place and believe it was the creation point of the universe. Kevin C. MacDonald

Igbo, or *Ibo,* are one of the largest ethnic groups in Nigeria. The Igbo population is estimated at about 15 million. The Igbo inhabit the southeastern section of Nigeria, a region of tropical rain forests near the Atlantic coast. The term *Igbo* also refers to the group's territory and to their language.

The Igbo language, which belongs to the Niger-Congo family of African languages, consists of many di-

alects. Some of the dialects differ so greatly that people may have difficulty understanding each other.

Most Igbo farm the land for a living. Their chief agricultural products include yams, two other root crops called *cassava* and *cocoyam,* palm oil, and corn.

Igbo culture emphasizes self-reliance, equality among people, democratic processes, and vigorous competition for social, economic, and political achievement. The Igbo highly value power and social standing.

Traditional Igbo society consisted of independent *village groups* (confederations of villages) and *city-states* (cities and their surrounding territory). These communities were linked by religious and professional groups, a network of markets, and shrines they all shared.

The origin of the Igbo people is obscure. However, archaeological evidence suggests that they have occupied their present territory since prehistoric times. Recent archaeological discoveries indicate that the early Igbo had an artistic culture supported by flourishing agriculture and highly developed trade.

The Igbo's location near the Nigerian coast made them active in the slave trade, which lasted from the 1400's to the 1800's. Their location also enabled many Igbo to attend missionary schools, which prepared them to take jobs under British rule. The United Kingdom gained control of Nigeria during the late 1800's and early 1900's and ruled the nation until 1960.

In 1967, the Eastern Region of Nigeria, which included the Igbo homeland, declared itself the independent republic of Biafra. Most Igbo strongly supported independence for the region. Civil war broke out between Biafra and the rest of Nigeria and lasted until 1970, when Biafra surrendered. Victor Chikezie Uchendu

See also Nigeria (People; History).

Igloo is the Inuit name for a shelter. The Inuit are sometimes called Eskimos. Traditional Inuit shelters were made of snow, sod, or stone. The best-known igloo was the winter snowhouse of the Canadian Inuit. Hard-packed snow was cut into blocks from 2 to 3 feet (61 to 91 centimeters) long and 1 to 2 feet (30 to 61 centimeters) wide. The blocks were fitted together in a spiral that became smaller toward the top to form a dome. A hole poked through the top admitted fresh air, and seal oil lamps supplied heat. The entrance was a tunnel that trapped cold air. A thin slab of ice may have been set in the igloo wall for a window, and shelves for utensils were cut in the walls. The Inuit ate and slept on a raised snow platform covered with furs. Some family snowhouses were as much as 10 feet (3 meters) wide. Prefabricated houses have replaced igloos. Claus-M. Naske

See also Inuit (Shelter; pictures).

Ignatius, *ihg NAY shuhs,* **Saint,** was a bishop of Antioch and an early Christian martyr. He was supposed to have been born in Syria about A.D. 50. Ignatius is famous for seven letters he wrote to various churches as he traveled as a prisoner to Rome, where he was martyred. His letters were important for their ideas about martyrdom and were influential in establishing the practice of having single bishops as leaders of churches. Ignatius's feast day is February 1. Stanley K. Stowers

Ignatius Loyola, Saint. See Loyola, Saint Ignatius.

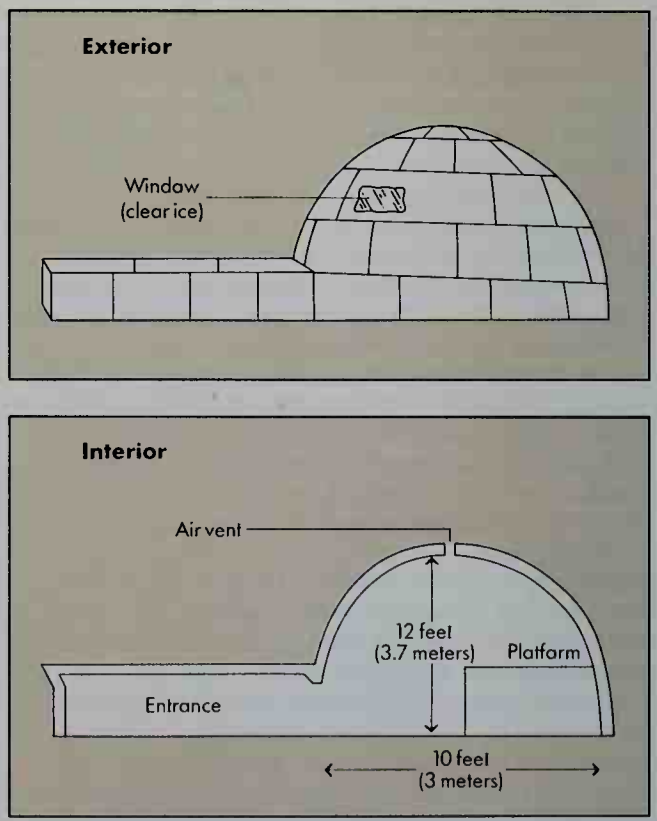
Igneous rock, *IHG nee uhs,* is rock formed by the hardening and crystallization of molten material that originates deep within the earth. This material, called *magma,* is usually a mixture of liquid rock, gases, and mineral crystals. Igneous rocks are one of the three major types of rocks. The other types are *metamorphic rocks* and *sedimentary rocks.* See **Rock**.

Scientists classify igneous rocks into two groups—*extrusive* and *intrusive.* Extrusive rocks form when magma flows onto the surface of the earth or floor of the ocean and then cools and hardens. Intrusive rocks result when magma solidifies beneath the earth's surface.

Extrusive igneous rocks are formed by magma that reaches the earth's surface along *fissures* (deep cracks) and at volcanic vents. This magma that flows onto the surface is called *lava.* It forms broad flat sheets, or it may build up a volcanic shape by repeatedly erupting from a vent. Most types of lavas cool rapidly, resulting in the formation of rocks composed mainly of microscopic crystals. Some lavas cool so quickly that they form a smooth volcanic glass called *obsidian.* A porous volcanic glass called *pumice* results when gases bubble out of the solidifying lava.

Intrusive igneous rocks are found in mines and tunnels, or at the surface where they have been exposed by geological uplifting and by erosion. Intrusive rock formations vary from thin sheets to huge, irregular masses. Magma that forms intrusive rocks solidifies relatively slowly, and so most intrusive rocks have larger crystals than do extrusive rocks.

Two principal types of igneous rocks are *basalt* and *granite.* Basalt is an extrusive rock, and granite is an intrusive rock. Basalt consists chiefly of the silicate minerals *plagioclase feldspar* and *pyroxene.* Granite is composed mainly of *quartz, alkali feldspar,* and *plagioclase*



WORLD BOOK illustration by Arthur Grebetz

An igloo was often made of blocks of snow that spiraled upward to form a dome, *top.* A hole in the roof admitted fresh air, and a snow platform was used for eating and sleeping, *bottom.*

feldspar. Basalt occurs on volcanic islands and makes up a large part of the oceanic crust, including mid-ocean ridges. Basalt is also found on continents. But the continents consist largely of granite and of metamorphic rocks that are formed from granite. Maria Luisa Crawford

See also **Basalt; Feldspar; Granite; Pyroxene; Quartz.**

Ignition is any system that sets fire to a mixture of fuel and air to create power in an engine. The two main kinds of ignition are *spark* and *compression.* Spark ignition systems are used in the gasoline engines found in most automobiles. Diesel engines use compression ignition. This article discusses spark ignition, the more common type. For information about compression ignition, see **Diesel engine.**

In a gasoline engine, spark plugs ignite the fuel-air mixture. One plug is mounted in each of the engine's cylinders. The plug has two electrical terminals that project into the cylinder's combustion chamber. The ignition system causes a high-voltage current to "jump" from one terminal to the other. This "jump" creates the spark. See **Gasoline engine** (illustration: How a four-stroke cycle gasoline engine works).

Most spark ignition systems create electric current by means of a 12-volt storage battery. Others use a device called a *magneto* (see **Magneto**). Battery ignition is used in automobiles.

Parts of an ignition system. There are two main kinds of battery ignition systems: *direct fire* and *conventional electronic.* Both systems consist of an electric circuit that includes a battery; an *ignition switch,* which is operated by the ignition key; at least one *ignition coil;* at least one *transistor* (electronic switch); and the same number of spark plugs as there are engine cylinders. Both systems also have timing devices that cause a spark to be created just as the fuel-air mixture in a cylinder becomes tightly compressed and ready for burning.

An ignition coil is a kind of *induction coil,* a device that uses a low-voltage current to produce a high-voltage current (see **Induction coil**). The ignition coil consists of an iron core called a *magnetic core* and two sets of electric wires called *windings.* The *primary winding* is wound around the magnetic core and connected to the battery. This winding has from 100 to 200 *turns* (loops) of wire. The wire is about as thick as a straight pin.

The *secondary winding* is wrapped around the primary winding and connected to one or two spark plugs. This winding has from 15,000 to 20,000 turns of wire. The wire is about as thick as a human hair. The two windings are insulated so that current cannot flow from one winding to the other.

In systems in which two spark plugs are connected to the secondary winding, both plugs fire at the same time. In one cylinder, the fuel-air mixture is ready for burning. The other cylinder contains no fuel. This cylinder's plug fires as the last of the exhaust fumes from the previous firing are being forced out of the cylinder. The firing in this cylinder uses little energy.

How an ignition system operates. When the driver of the car turns the ignition key to start the car, the ignition switch closes. Low-voltage current flows from the battery to the primary winding. This current creates a magnetic field within and around the magnetic core. Next, a timing device causes the transistor to open the circuit that contains the primary winding. As a result, the current in this winding stops. The magnetic field therefore collapses, generating a high-voltage current in the secondary winding. This current creates a spark in the plug or plugs that are connected to this winding. The timing device then causes the transistor to close the primary circuit, and the process repeats.

The direct-fire ignition system is used in most cars built since the mid-1980's. For every two cylinders, this system has one ignition coil, one transistor, and one *electronic control circuit.* An *ignition module* contains the control circuits, transistors, and a timing device. The ignition module is linked to a *vehicle computer.* The vehicle computer contains a tiny silicon chip called a *microprocessor* that controls many of the car's systems. The microprocessor sets the timing of the sparks based on engine load, engine speed, and other factors, and instructs the timing device to send firing signals to the control circuits when appropriate.

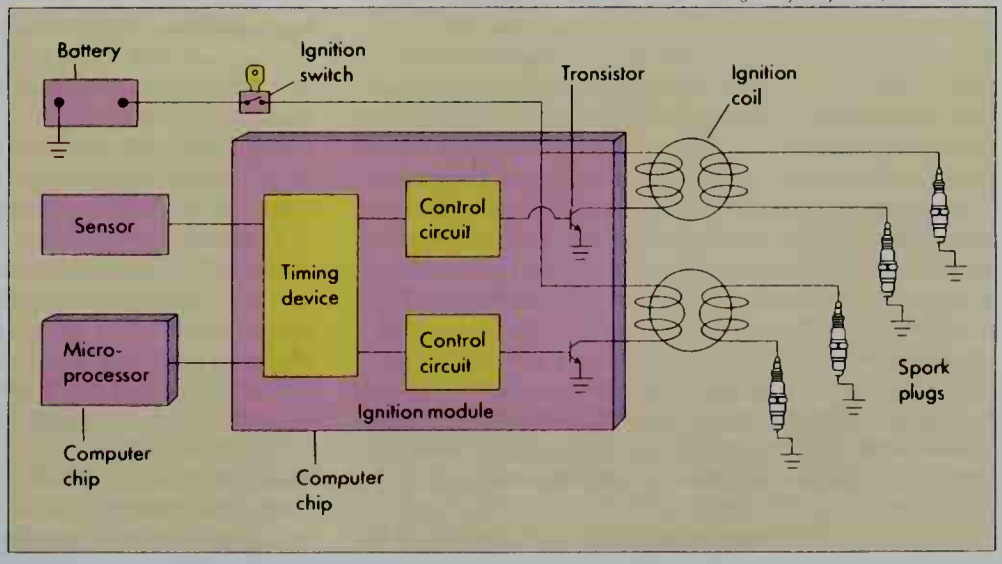
The timing device uses information from the microprocessor and an electric device called a *sensor* to determine when to fire a plug. The sensor detects the rotation of the car's *crankshaft,* a mechanical part that transmits energy from the cylinders to the drive shaft.

The conventional electronic ignition system is

WORLD BOOK diagram by Andy Miller, Graham Studios

How a direct-fire automobile ignition system works

When the ignition switch is turned on, low-voltage currents flow from the battery to ignition coils. *Transistors* (switches) open, interrupting these currents and causing high-voltage currents to flow in separate circuits. The high-voltage currents create sparks in spark plugs, setting fire to the fuel-air mixture in the engine. The timing of the transistors is controlled by a sensor that detects engine speed, a *microprocessor* (a computer built into a silicon chip), and other electronic devices.



found in most cars manufactured from the 1970's to the mid-1980's. It has a single ignition coil and transistor, and it fires only one plug at a time. The high-voltage current in this system passes through a mechanical part called a *distributor.* Inside the distributor, a small rotating arm called a *rotor* sends the high-voltage current through wires connected to the spark plugs.

Development of ignition systems. Before the 1970's, ignition systems were largely mechanical. The distributor contained a rotating, many-sided wheel called a *breaker cam* that continually opened and closed electrodes called *breaker points* to interrupt the low-voltage current. In the mid-1970's, ignition systems began to include electronic parts. An electronically controlled transistor replaced the points. Later, a magnetic wheel replaced the cam.

In the early 1980's, many ignition systems began to use a microprocessor instead of a mechanical device to regulate spark timing. In the mid-1980's, carmakers introduced direct ignition systems. William H. Haverdink

Iguaçu Falls, *EE gwah SOO,* is a spectacular system of waterfalls located on the Iguaçu River at the border between Brazil and Argentina. The falls, which is also spelled Iguazú Falls, ranks among the major tourist attractions of South America.

The Iguaçu Falls consists of about 275 individual waterfalls separated by forested islands. It has a total combined width of about 2 miles (3 kilometers) and plunges about 237 feet (72 meters) down a series of ledges.

The falls and the surrounding forests and wildlife are protected by national parks in both Brazil and Argentina. People can reach individual falls by means of hiking trails and *catwalks* (elevated walkways) on both sides of the river, or by boat. The whole system of falls can be seen only from the air or from certain places on the Brazilian side. Gregory Knapp

See also National park (picture).

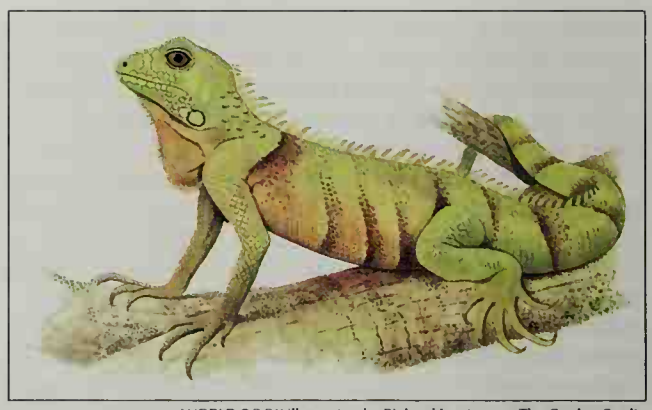
Iguana, *ih GWAH nuh,* is the name of certain lizards found mainly in the Western Hemisphere. Most iguanas live in deserts or other dry habitats, but a few species live in tropical rain forests. All iguanas are active during the day and sleep at night.

The *green iguana,* also called the *common iguana,* is found from Mexico to southern Brazil and Paraguay. Green iguanas may grow to 6 feet (1.8 meters) in length. These iguanas have a large flap of skin called a *dewlap* at their throat and a crest of scales along their back and long tail. Their color ranges from gray to green, with brown bands around the body and tail. Green iguanas and their eggs are often eaten for food. Also, these lizards are often captured for the pet trade. As a result, green iguanas are in danger of extinction in many areas.

Green iguanas live in trees, especially near water. They typically lie motionless on horizontal branches and rarely move. When attacked by an enemy, they leap out of trees and hide underwater. If cornered on land, they use their long tail as a lash.

Iguanas eat fruit, flowers, and leaves. Most other lizards eat insects. Plants are difficult for most other lizards to digest. The iguana's digestive system contains certain bacteria that help the animal digest plants. Iguanas are born without these bacteria and possibly obtain them by eating the *feces* (solid body wastes) of adult iguanas.

All species of iguanas lay eggs. Females may travel up to 2 miles (3.2 kilometers) to a suitable nesting site. They then dig a tunnel and bury as many as 75 eggs at the bottom. Some females may guard the nest for several days or longer. The young hatch after 10 to 14 weeks and dig to the surface. Newborn green iguanas may leave the nest in small groups, probably for protection from enemies. Iguanas grow slowly and may take two years to mature. Some iguanas live for 30 years or more.



WORLD BOOK illustration by Richard Lewington, The Garden Studio

The green iguana has a crest of scales down the middle of its back. This lizard lives in trees.

The *marine iguana* and the *land iguana* live on the Galapagos Islands, located off the coast of Ecuador. The marine iguana is the only lizard that lives in the sea. It is found along coastal rocks and dives underwater to search for algae to eat. In the 1990's, scientists discovered that marine iguanas can shrink in size by as much as 20 percent when food is scarce. The animals' bones become smaller during these periods. Marine iguanas are the first known *vertebrates* (backboned animals) to reduce the size of their bones to adapt to a changing environment. The land iguana never goes near water. It eats cactuses and other land plants. Other iguanas include the *ground iguana* of the West Indies, the *spiny-tailed iguana* of Mexico and Central America, the *desert iguana* and the *chuckwalla* of the southwestern United States and northern Mexico, and the *banded iguana* of Fiji and Tonga in the South Pacific. Raymond B. Huey

Scientific classification. Iguanas belong to the iguana family, Iguanidae. The scientific name for the green iguana is *Iguana iguana.* The marine iguana is *Amblyrhynchus cristatus.* The land iguana is *Conolophus subcristatus.*

Iguanodon, *ih GWAN uh dahn,* a large plant-eating dinosaur, was one of the first dinosaurs discovered. Mary Ann Mantell first found *Iguanodon* teeth in Sussex, England, in 1822. Her husband, amateur geologist Gideon Mantell, gave the dinosaur its name in 1825. Iguanodon means *iguana tooth,* and Mantell believed the dinosaur's teeth resembled those of modern iguanas.

Iguanodon grew about 30 feet (9 meters) long and weighed from 4 to 5 tons (3.6 to 4.5 metric tons). It used its horny beak and strong teeth to chop and grind up plants. *Iguanodon*'s arms were shorter than its long, muscular hind legs. Its five-fingered hands had a cone-shaped spike on each thumb. Scientists believe the dinosaur used its spikes to defend itself and to direct tree branches toward its mouth. *Iguanodon* also had three hoofed toes on each foot. Large adults walked on all fours, but smaller, younger animals could travel on two legs. The dinosaur's long tail provided balance.

Oxford Museum of Natural History

An *Iguanodon* could stand and walk on two legs, but it usually walked on all fours. This *Iguanodon* skeleton stands in the Oxford University Museum of Natural History in England.

Iguanodon lived about 135 million to 125 million years ago, during the Early Cretaceous Period. Scientists have found its fossils on every continent except Antarctica. Some expeditions have uncovered large *bone beds* containing dozens of *Iguanodon* fossils. These findings suggest that the animal lived in herds. Kenneth Carpenter

See also **Dinosaur** (picture: When dinosaurs lived).

Ikhnaton. See Akhenaten.

Ileitis. See Crohn's disease.

Ileum. See Crohn's disease.

Iliad, *IHL ee uhd,* is one of the oldest surviving Greek poems. According to tradition, it was composed by the ancient Greek poet Homer, probably in the 700's B.C. The *Iliad* describes certain events in the final year of the Trojan War, which was fought between Greece and the city of Troy. According to legend, the Trojan War lasted 10 years, until Greece defeated Troy. For information on the historical background and authorship of the *Iliad,* see **Homer; Trojan War.**

According to the *Iliad,* the Trojan War was fought over Helen, the beautiful wife of King Menelaus of Sparta. Helen had been taken from Sparta to the city of Troy by Paris, a son of the Trojan king, Priam. Menelaus's brother, Agamemnon, led an army of Greek heroes to bring Helen back to Sparta.

The *Iliad* is divided into 24 *books* (sections). The story covers 54 days. Most of the action takes place in the Greek camp, inside the walls of Troy, and in nearby areas. A quarrel develops between Agamemnon and Achilles, the greatest of the young Greek heroes. Achilles feels he is not being adequately rewarded for his services to the Greeks. Agamemnon, in turn, feels that Achilles does not have enough respect for his position as commander of the army. Achilles withdraws into his tent and refuses to fight. Without Achilles, the Greeks are driven back to their ships by Trojan forces led by Hector, another of Priam's sons. Achilles's closest friend, Patroclus, goes to fight in Achilles's armor to help the Greeks. Hector kills Patroclus, which arouses Achilles to seek revenge. Achilles then kills Hector outside Troy. He keeps Hector's body, until Priam comes to plead with him. Achilles takes pity on Priam and gives him the body for proper burial. The story ends with Hector's funeral.

For nearly 3,000 years, readers have found the *Iliad* a moving expression of the heroism, idealism, and tragedy of war. It describes the emotional farewell between Hector and his wife, Andromache, who foresees his death. Hector is a great soldier. But he basically represents the family man who is called on to defend his country and, in so doing, loses his life. The poem also deals with issues of honor and social obligation.

Cynthia W. Shelmerdine

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Ajax the Greater	Hector	Odyssey	Troy
	Helen of Troy	Paris	Ulysses

Illegal alien, also called an *undocumented alien,* is a noncitizen living in a country without the proper immigration documents. Some illegal aliens have fled poverty, war, starvation, and persecution in their native lands. Others are seeking better job opportunities in countries with stronger economies. Illegal immigration has been a growing problem for governments since the early 1900's. The nations most affected by illegal aliens are those with a high standard of living: the United States, Canada, and the nations of Western Europe.

Many illegal aliens come to the United States from Mexico or Central America. After 1945, the United States built more fences and posted extra police along its nearly 2,000-mile (3,200-kilometer) border with Mexico. The U.S. Border Patrol catches tens of thousands of people trying to cross the border each year. Many illegal aliens, however, cross successfully into the United States.

Canada has fewer illegal aliens than the United States. Most arrive by plane or boat, hoping to avoid detection. If caught entering Canada or the United States, aliens may claim political *asylum* (shelter) and receive a court hearing on their claim. If a judge grants them asylum, they may remain in the country. Many do not appear in court, however, for fear of being *deported* (sent home).

Western Europe faced problems in the late 1900's when many people from Eastern Europe, the Middle East, and Africa immigrated there. These people sought refuge from economic hardship and political and ethnic persecution. Sometimes, the country they hoped to enter rejected them. During the 1990's, for example, Italy sent back many Albanians trying to enter the country.

Opinions about illegal aliens differ. For example, some people do not want their taxes to pay for public services, such as schools, used by these immigrants. Defenders of illegal aliens note that these aliens also pay taxes. Some critics say that because aliens often work for low wages, they are hired for jobs in place of the legal residents of a country. Others argue that aliens usually take jobs legal residents do not want. David M. Reimers

See also **Border Patrol, United States; Deportation; Immigration.**

Illini Indians. See Illinois Indians.

J. C. Allen and Son

A vast cornfield symbolizes the importance of Illinois as a leading agricultural state. Corn grows on about 45 percent of Illinois farmland, and the state produces about one-sixth of the nation's corn crop. Illinois also ranks among the leading states in soybean production. Other important crops include hay and wheat.

Illinois *The Land of Lincoln*

Illinois, *ihl uh NOY,* has more people than any other state in the Midwestern region of the United States. About two-thirds of the people of Illinois live in and around Chicago, one of the world's leading industrial and transportation centers. In addition, millions of Illinoisans live in the smaller cities and on the farms that dot the state's gently rolling plains. These plains cover most of Illinois, and have given the state one of its nicknames, the Prairie State.

The people of Illinois also call their state the Land of Lincoln. They are proud of the fact that Abraham Lincoln, the 16th president of the United States, lived most of his life in their state. He was buried in Springfield, the state capital.

Many other famous people helped make history in Illinois. These people included industrialists Cyrus H. McCormick and George M. Pullman; writers Gwendolyn Brooks and Carl Sandburg; architects Louis Sullivan and Frank Lloyd Wright; reformers Jane Addams and Florence Kelley; and political leader Stephen A. Douglas. Ronald Reagan, the 40th president of the United States, was born in Tampico, in northern Illinois.

In 1942, Enrico Fermi and other scientists at the University of Chicago made a major advance in the development of the atomic bomb. In laboratories under the university's football stands, they produced the first controlled chain reaction that created nuclear energy. Today, Illinois ranks as an international center for the study of the atom. Scientists from throughout the world come to the state to do research at the Fermi National Accelerator Laboratory. This laboratory, near Chicago, contains one of the largest atom smashers in the world.

The land of Illinois, part of the great Midwestern Corn Belt, has helped make the state rich. Illinois ranks among the leading states in agriculture. And beneath its fertile plains lie the country's largest beds of *bituminous* (soft) coal. But most Illinois workers are employed in service industries, which include education, health care, and

The contributors of this article are Theodore J. Karamanski, Professor of History at Loyola University Chicago, and William D. Walters, Jr., Professor of Geography at Illinois State University.

Interesting facts about Illinois

The 10-story Home Insurance Building, often considered the world's first metal-framed skyscraper, was built in Chicago in 1884 and 1885.

Kaskaskia Island is the only part of Illinois that lies west of the Mississippi River.

A practical machine for manufacturing barbed wire was invented in 1874 by Joseph Glidden of De Kalb. It helped to settle the West by allowing farmers to protect crops from grazing cattle.

The Chicago River is known as the *river that flows backward.* It flowed into Lake Michigan until 1900, when engineers reversed the flow to prevent pollution of the water used in the city water system. The river now flows from the lake.

Home Insurance Building

WORLD BOOK illustrations by Kevin Chadwick

The Pullman

The Pullman, the first successful railroad sleeping car, was built by George M. Pullman in Bloomington in 1858. Pullman also introduced a dining car that had its own kitchen, a parlor car, and a vestibule that directly connects railroad cars.

Innovations in farm equipment produced in Illinois made large-scale farming possible. John Deere developed the steel plow in Grand Detour in 1837. Cyrus McCormick began to manufacture mechanical reapers in Chicago in 1847.

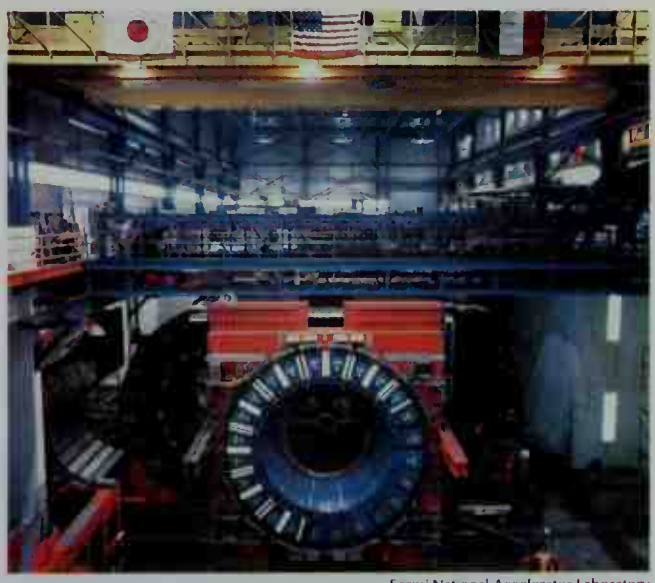
© Churchill & Klehr

Downtown Chicago has many pleasant outdoor gathering places, such as the Bank One Plaza, shown here. A colorful mosaic by artist Marc Chagall stands in the background. About two-thirds of the people of Illinois live in and around Chicago, the nation's third largest city.

retail trade. Illinois also ranks among the top manufacturing states. The production of machinery is the leading manufacturing activity in Illinois.

The fur trade with Indians first made Illinois commercially important during the late 1600's. Traders paddled canoes filled with furs down the Chicago River to Lake Michigan. The pelts were then transported in wooden sailing ships. Today, ocean freighters arrive from the Atlantic Ocean through the St. Lawrence Seaway and the Great Lakes, and carry Illinois products to many parts of the world. Busy river barges transport cargo on the Illinois Waterway, which links with the Mississippi River and the Gulf of Mexico.

The first Europeans in the Illinois region were probably the French explorers Louis Jolliet and Jacques Marquette, who arrived in 1673. The French settlers who came after Jolliet and Marquette named the region for the Illinois, or Illini, Indians. These Indians formed a group of united tribes that lived in the area before the European settlers came. The Indians called themselves *Iliniwek* (superior men). The name Illinois came from the French settlers' spelling and pronunciation of Iliniwek.



Fermi National Accelerator Laboratory

Fermi National Accelerator Laboratory is a physics research facility near Batavia. The collider detector shown here is part of the laboratory's particle accelerator, or atom smasher.

Illinois in brief

Symbols of Illinois

The state flag, first adopted in 1915, bears the state seal. A 1970 statute added the name *Illinois* and ensured uniformity in design. On the seal, adopted in 1868, a bald eagle holds a shield with stars and stripes that represent the original 13 states. The laurel leaves symbolize the great achievements of Illinois citizens. The sun rising over the prairie stands for the progress made since statehood and for the future.

State flag

State seal

Illinois (brown) ranks 24th in size among all the states and 8th in size among the Midwestern States (yellow).

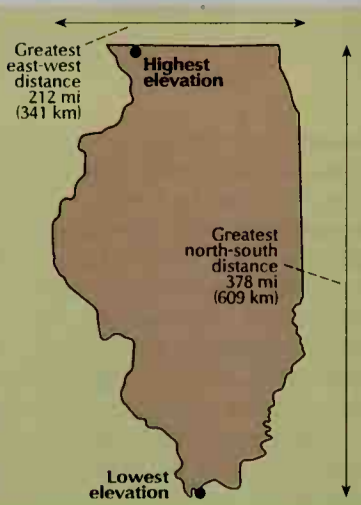
General information

Statehood: Dec. 3, 1818, the 21st state.
State abbreviations: Ill. (traditional); IL (postal).
State motto: *State Sovereignty, National Union.*
State song: "Illinois." Words by Charles H. Chamberlin; sung to the tune of "Baby Mine" by Archibald Johnston.

The State Capitol is in Springfield, the capital of Illinois since 1839. Earlier state capitals were Kaskaskia (1818-1820) and Vandalia (1820-1839).

Land and climate

Area: 56,343 mi² (145,928 km²), including 750 mi² (1,941 km²) of inland water but excluding 1,575 mi² (4,079 km²) of Great Lakes water.
Elevation: *Highest*—Charles Mound, 1,235 ft (376 m) above sea level. *Lowest*—279 ft (85 m) above sea level along the Mississippi River in Alexander County.
Record high temperature: 117 °F (47 °C) at East St. Louis on July 14, 1954.
Record low temperature: −36 °F (−38 °C) at Congerville on Jan. 5, 1999.
Average July temperature: 76 °F (24 °C).
Average January temperature: 26 °F (−3 °C).
Average yearly precipitation: 38 in (97 cm).



Important dates

1673 — Marquette and Jolliet were probably the first Europeans to enter the Illinois region.

1699 — French priests founded a settlement at Cahokia, the oldest town in Illinois.

1783 — The Illinois region became part of the United States under the treaty ending the Revolutionary War.

1809 — Congress made Illinois a territory.

State bird
Cardinal

State flower
Native violet

State tree
White oak

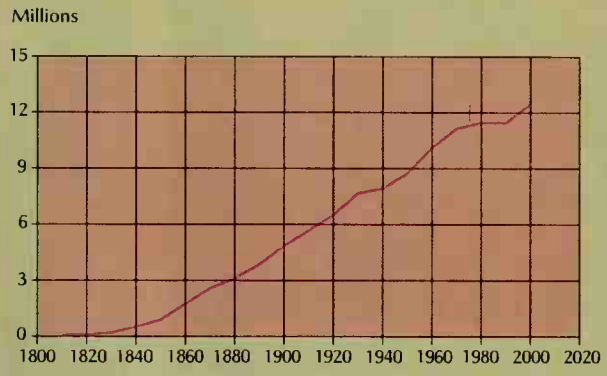
People

Population: 12,419,293 (2000 census)
Rank among the states: 5th
Population density: 220 per mi² (85 per km²), U.S. average 78 per mi² (30 per km²)
Distribution*: 85 percent urban, 15 percent rural
Largest cities in Illinois

Chicago	2,896,016
Rockford	150,115
Aurora	142,990
Naperville	128,358
Peoria	112,936
Springfield	111,454

Source: 2000 census, except for *, where figures are for 1990.

Population trend



Year	Population
2000	12,419,293
1990	11,466,682
1980	11,427,414
1970	11,110,285
1960	10,081,158
1950	8,712,176
1940	7,897,241
1930	7,630,654
1920	6,485,280
1910	5,638,591
1900	4,821,550
1890	3,826,352
1880	3,077,871
1870	2,539,891
1860	1,711,951
1850	851,470
1840	476,183
1830	157,445
1820	55,211
1810	12,282

Source: U.S. Census Bureau.

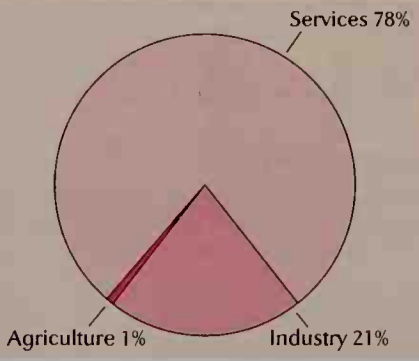
Economy

Chief products

Agriculture: corn, soybeans, hay, hogs, beef cattle, milk, wheat.
Manufacturing: machinery, food products, chemicals, fabricated metal products, electronic equipment, printed materials.
Mining: coal, petroleum, crushed stone, sand and gravel.

Gross state product

Value of goods and services produced in 1998: $425,680,000,000. *Services* include community, business, and personal services; finance; government; trade; and transportation and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture and fishing.



Source: U.S. Bureau of Economic Analysis.

Government

State government

Governor: 4-year term
State senators: 59; 2- or 4-year terms
State representatives: 118; 2-year terms
Counties: 102

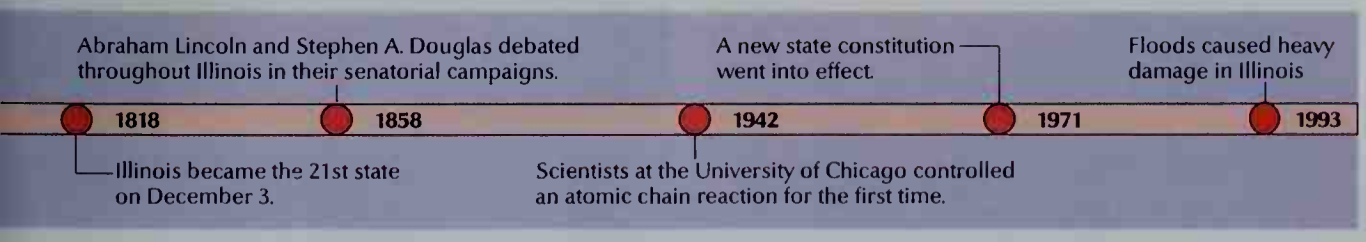
Federal government

United States senators: 2
United States representatives*: 20 (19)
Electoral votes*: 22 (21)

*Figures in parentheses are for January 2003 and beyond.

Sources of information

For information about tourism, write to: Illinois Department of Commerce and Community Affairs, Illinois Bureau of Tourism, 100 W. Randolph Street, 3-400, Chicago, IL 60601. The Web site at www.enjoyillinois.com also provides information.
For information on the economy, write to: Illinois Department of Commerce and Community Affairs, 620 E. Adams Street, Attention: Research Office, Springfield, IL 62701.
The state's official Web site at www.state.il.us also provides a gateway to much information on Illinois's economy, government, and history.



Population. The 2000 United States census reported that Illinois had 12,419,293 people. The population had increased nearly 9 percent over the 1990 census figure, 11,430,602. According to the 2000 census, Illinois ranks fifth in population among the 50 states.

About 85 percent of the people of Illinois live within metropolitan areas. About two-thirds live in the Chicago metropolitan area. This area includes about 170 incorporated cities, towns, and villages. Ten metropolitan areas are located either partly or entirely in Illinois (see **Metropolitan area**). For the names and populations of these areas, see the *Index* to the political map of Illinois.

Chicago is the largest city in Illinois. Other large Illinois cities, in order of population, include Rockford, Aurora, Naperville, Peoria, and Springfield.

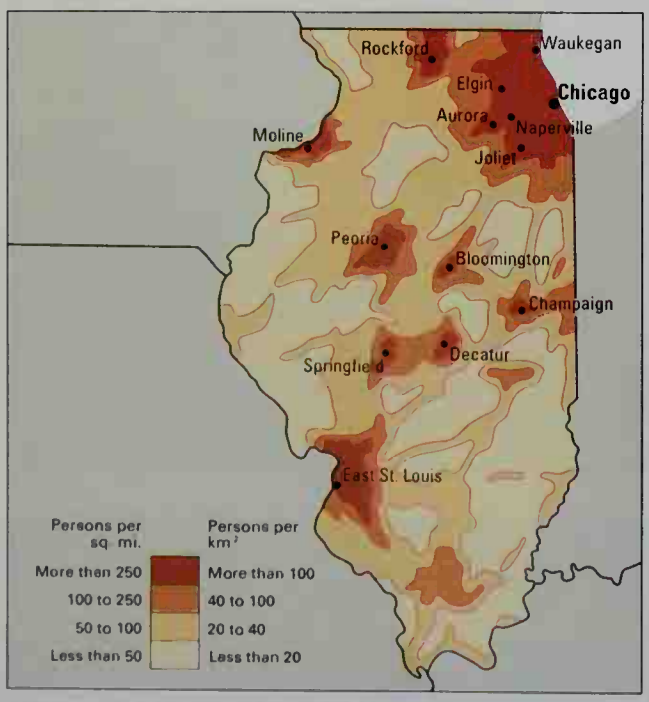
About 91 percent of the people of Illinois were born in the United States. Most of the people who were born outside the United States live in the Chicago area. Mexicans make up about 30 percent of the people born outside the country. Nearly 10 percent of the foreign-born population came from Poland. About 15 percent of the state's people are African Americans. People of German, Irish, English, Polish, and Italian descent also make up large population groups.

Schools. The first known Illinois school began in 1784 in Cahokia. Public schools did not become common until after 1825, when the legislature established the state's public school system.

The governor appoints a nine-member State Board of Education to determine policies for public schools. Board members serve six-year terms. The board appoints a state superintendent of education to supervise the school system. Illinois school districts are controlled by local elected school boards, except in Chicago where

Population density

Illinois is one of the most populous states. About 85 percent of the state's people live in the state's metropolitan areas. About two-thirds of them live in the Chicago metropolitan area.



WORLD BOOK map, based on U.S. Census Bureau data.

Artstreet

An art fair in Chicago's Old Town neighborhood is an annual cultural event. Old Town, located north of downtown Chicago, has many charming old homes that have been modernized.

University of Illinois

The University of Illinois at Urbana-Champaign has the largest enrollment of any campus in the state. The Illini Union, *shown here,* stands on the main quadrangle of the campus.

the board is appointed. However, each Chicago public school has a local school council of elected members. Children from age 7 through 15 must attend school.

Besides colleges and universities listed in the table in this section, Illinois has more than 40 community colleges and about 25 vocational centers. For the number of students and teachers in Illinois, see **Education** (table).

Libraries. The first public library in Illinois opened in 1818 in Albion. The largest public library in the state, the Chicago Public Library, opened in 1873. Other libraries in Chicago include the John Crerar Library, a world-famous scientific institution; and the Newberry Library, with collections on genealogy, history, and literature.

The Illinois State Historical Library in Springfield has large collections of books on Abraham Lincoln and on Illinois history. The Illinois State Library, also in Springfield, serves libraries throughout the state.

Museums. The Art Institute of Chicago has fine collections of French paintings of the late 1800's and early 1900's. The Museum of Science and Industry in Chicago includes a realistic model of a coal mine. Chicago's Adler Planetarium, dedicated in 1930, was the first planetarium in the Western Hemisphere. Other museums include the John G. Shedd Aquarium and a natural history museum called the Field Museum, both in Chicago; the Lakeview Museum of Arts and Sciences in Peoria; and the Burpee Museum of Natural History in Rockford. The Illinois State Museum in Springfield includes collections and exhibits in natural history and art.

© 1999 Museum of Science and Industry, Chicago (photo by Dirk Fletcher)

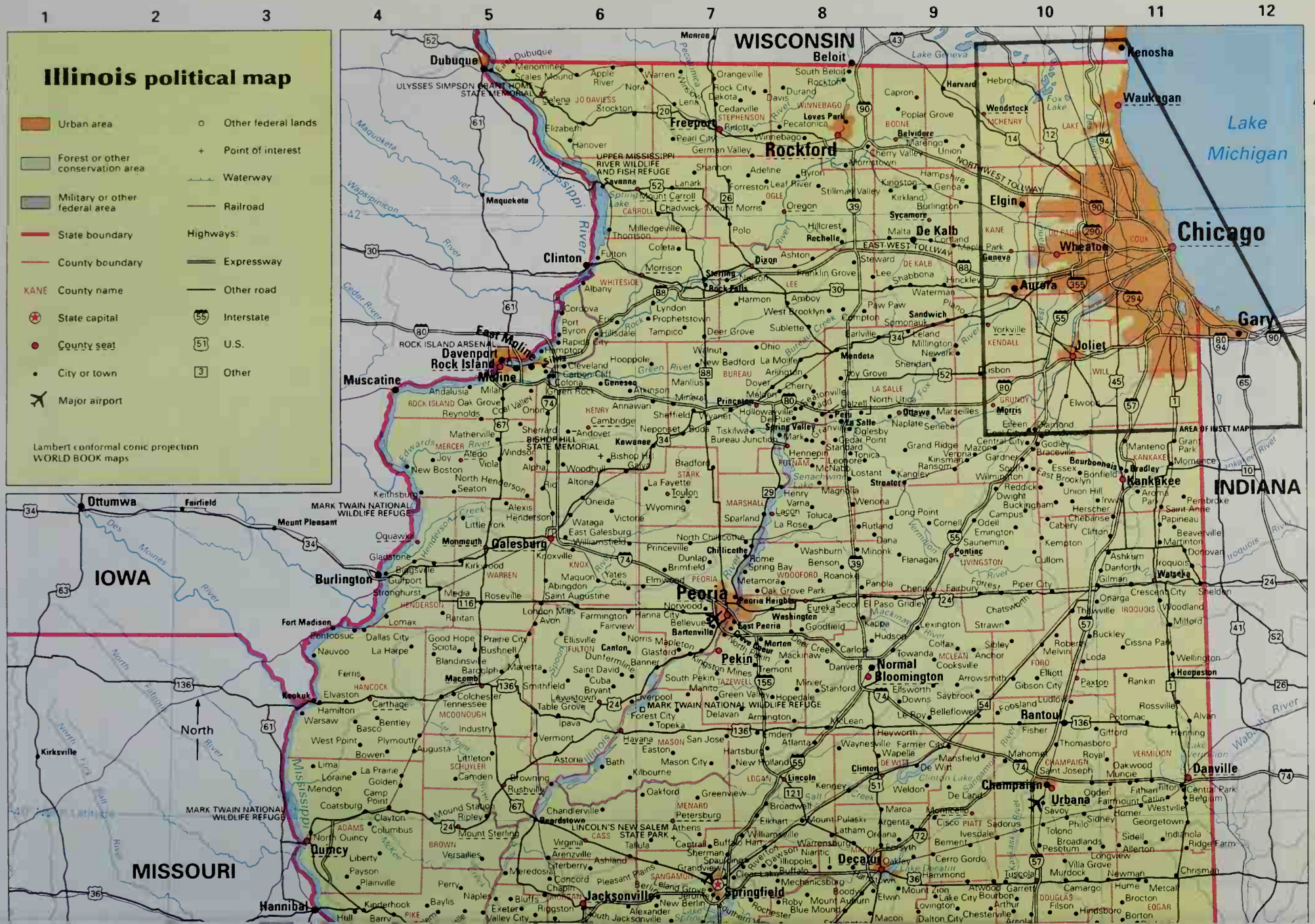
At Chicago's Museum of Science and Industry, visitors can explore a giant-sized reproduction of the human heart. The walk-through heart is one of the museum's most popular exhibits.

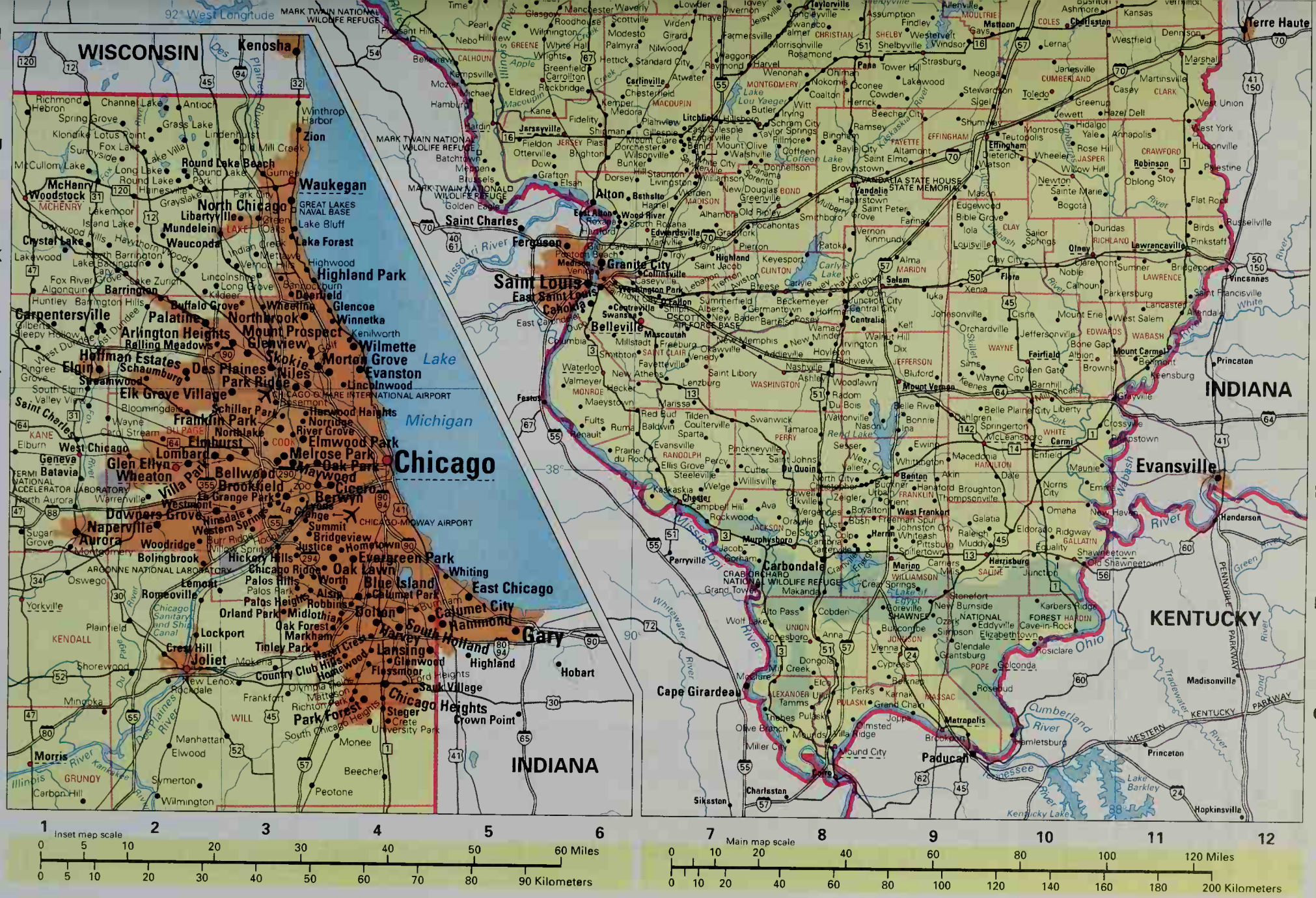
Universities and colleges

This table lists the universities and colleges in Illinois that grant bachelor's or advanced degrees and are accredited by the North Central Association of Colleges and Schools.

Name	Mailing address
Adler School of Professional Psychology	Chicago
Argosy University	*
Art Institute of Chicago, School of the	Chicago
Augustana College	Rock Island
Aurora University	Aurora
Barat College	Lake Forest
Benedictine University	Lisle
Blackburn College	Carlinville
Blessing-Rieman College of Nursing	Quincy
Bradley University	Peoria
Catholic Theological Union	Chicago
Chicago, University of	Chicago
Chicago School of Professional Psychology	Chicago
Chicago State University	Chicago
Chicago Theological Seminary	Chicago
Clinical Social Work, Institute for	Chicago
Columbia College Chicago	Chicago
Concordia University	River Forest
DePaul University	Chicago
DeVry Institute of Technology	†
Dr. William M. Scholl College of Podiatric Medicine	Chicago
Dominican University	River Forest
East-West University	Chicago
Eastern Illinois University	Charleston
Elmhurst College	Elmhurst
Erikson Institute	Chicago
Eureka College	Eureka
Finch University of Health Sciences/Chicago Medical School	North Chicago
Garrett-Evangelical Theological Seminary	Evanston
Governors State University	University Park
Greenville College	Greenville
Hebrew Theological College	Skokie
Illinois, University of	‡
Illinois College	Jacksonville
Illinois College of Optometry	Chicago
Illinois Institute of Technology	Chicago
Illinois State University	Normal
Illinois Wesleyan University	Bloomington
John Marshall Law School	Chicago
Judson College	Elgin
Keller Graduate School of Management	Oakbrook Terrace
Kendall College	Evanston
Knowledge Systems Institute	Skokie
Knox College	Galesburg
Lake Forest College	Lake Forest
Lake Forest Graduate School of Management	Lake Forest
Lakeview College of Nursing	Danville
Lewis University	Romeoville
Lincoln Christian College	Lincoln
Lincoln College	Lincoln
Loyola University Chicago	Chicago
Lutheran School of Theology at Chicago	Chicago
MacMurray College	Jacksonville
McCormick Theological Seminary	Chicago
McKendree College	Lebanon
Midstate College	Peoria
Midwestern University	Downers Grove
Millikin University	Decatur
Monmouth College	Monmouth
Moody Bible Institute	Chicago
National University of Health Sciences	Lombard
National-Louis University	Evanston
North Central College	Naperville
North Park University	Chicago
Northeastern Illinois University	Chicago
Northern Baptist Theological Seminary	Lombard
Northern Illinois University	De Kalb
Northwestern University	Evanston
Olivet Nazarene University	Bourbonnais
Principia College	Elsah
Quincy University	Quincy
Robert Morris College	Chicago
Rockford College	Rockford
Roosevelt University	Chicago
Rush University	Chicago
St. Anthony College of Nursing	Rockford
St. Augustine College	Chicago
St. Francis, University of	Joliet
St. Francis Medical Center College of Nursing	Peoria
St. John's College	Springfield
St. Xavier University	Chicago
Seabury-Western Theological Seminary	Evanston
Shimer College	Waukegan
Southern Illinois University	§
Spertus College	Chicago
Trinity Christian College	Palos Heights
Trinity College of Nursing	Moline
Trinity International University	Deerfield
VanderCook College of Music	Chicago
West Suburban College of Nursing	Oak Park
Western Illinois University	Macomb
Wheaton College	Wheaton

*Campuses at Chicago and Rolling Meadows.
†Campuses at Addison, Chicago, and Tinley Park.
‡Campuses at Chicago, Springfield, and Urbana-Champaign.
§Campuses at Carbondale and Edwardsville.


Illinois political map
Urban area
Forest or other conservation area
Military or other federal area
State boundary
County boundary
KANE County name
State capital
County seat
City or town
Major airport
Other federal lands
Point of interest
Waterway
Railroad
Highways:
Expressway
Other road
Interstate
U.S.
Other
Lambert conformal conic projection
WORLD BOOK maps
WISCONSIN
IOWA
MISSOURI
INDIANA
Lake Michigan
Chicago
Rockford
Freeport
Dubuque
Beloit
Kenosha
Waukegan
Elgin
Aurora
Joliet
Gary
Wheaton
De Kalb
Sycamore
Clinton
Davenport
Rock Island
Moline
East Moline
Muscatine
Galesburg
Burlington
Ottumwa
Fort Madison
Keokuk
Quincy
Hannibal
Peoria
Pekin
Bloomington
Normal
Champaign
Urbana
Danville
Springfield
Decatur
Jacksonville
Kankakee
Bradley
Watseka
Rantoul
Pontiac
Streator
Ottawa
Morris
Sterling
Dixon
Rochelle
Mendota
Princeton
Kewanee
Monmouth
Macomb
Canton
Lincoln
Mount Pulaski
Taylorville
Mattoon
Effingham
Centralia
Carbondale
Mount Vernon
Olney
Robinson
Paris
Charleston
Shelbyville
Litchfield
Alton
Edwardsville
Belleville
Mount Carmel
Wabash River
Ohio River
Mississippi River
Illinois River
Rock River
Fox River
Kankakee River
Iroquois River
Vermilion River
Sangamon River
Embarras River
Little Wabash River
Kaskaskia River
Big Muddy River
Spoon River
Green River
Bureau Creek
Crooked Creek
Sandy Creek
Lake Geneva
Lake Shelbyville
Carlyle Lake
Rend Lake
Clinton Lake
Lake Vermilion
Lake Springfield
Lake Decatur
Lake Paradise
Lake Mattoon
Lake Sara
Lake Shabbona
Lake Holiday
Lake Le-Aqua-Na
Lake Storey
Lake Chautauqua
Lake Senachwine
Lake Depue
Lake Petite
Lake Bracken
Lake Arrowhead
Lake Marie
Lake Glen Flora
Lake Crystal
Lake Ellyn
Lake Mary
Lake Fox
Lake Barrington
Lake Zurich
Lake Cook
Lake Louise
Lake Holiday
Lake Le-Aqua-Na
Lake Storey
Lake Chautauqua
Lake Senachwine
Lake Depue
Lake Petite
Lake Bracken
Lake Arrowhead
Lake Marie
Lake Glen Flora
Lake Crystal
Lake Ellyn
Lake Mary
Lake Fox
Lake Barrington
Lake Zurich
Lake Cook
Lake Louise
ULYSSES SIMPSON GRANT HOME STATE MEMORIAL
ROCK ISLAND ARSENAL
BISHOP HILL STATE MEMORIAL
LINCOLN'S NEW SALEM STATE PARK
MARK TWAIN NATIONAL WILDLIFE REFUGE
UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE
AREA OF INSET MAP
North
1
2
3
4
5
6
7
8
9
10
11
12
A
B
C
D
E
F
G
H


WISCONSIN
INDIANA
KENTUCKY
Chicago
Saint Louis
Evansville
Michigan Lake
92° West Longitude
38°
90
MARK TWAIN NATIONAL WILDLIFE REFUGE
CHICAGO O'HARE INTERNATIONAL AIRPORT
CHICAGO-MIDWAY AIRPORT
ARGONNE NATIONAL LABORATORY
CRAB ORCHARD NATIONAL WILDLIFE REFUGE
GREAT LAKES NAVAL BASE
Kenosha
Waukegan
North Chicago
Libertyville
Mundelein
Lake Forest
Lake Bluff
Highland Park
Zion
Round Lake Beach
McHenry
Woodstock
Crystal Lake
Wauconda
Barrington
Carpentersville
Palatine
Buffalo Grove
Wheeling
Deerfield
Glencoe
Winnetka
Northbrook
Mount Prospect
Arlington Heights
Rolling Meadows
Glenview
Wilmette
Hoffman Estates
Elgin
Schaumburg
Des Plaines
Skokie
Niles
Morton Grove
Evanston
Park Ridge
Lincolnwood
Elk Grove Village
Schiller Park
Harwood Heights
Norridge
River Grove
Franklin Park
Northlake
Elmwood Park
Melrose Park
Oak Park
Elmhurst
Lombard
Glen Ellyn
Wheaton
Bellwood
Maywood
Brookfield
Cicero
Berwyn
La Grange Park
Villa Park
Downers Grove
Naperville
Aurora
Westmont
Hinsdale
Western Springs
Summit
Bridgeview
Woodridge
Bolingbrook
Hickory Hills
Justice
Hometown
Evergreen Park
Chicago Ridge
Oak Lawn
Whiting
East Chicago
Palos Hills
Worth
Blue Island
Palos Heights
Alsip
Calumet Park
Robbins
Orland Park
Midlothian
Bolton
Calumet City
Hammond
Gary
Oak Forest
Markham
South Holland
Tinley Park
Harvey
Lansing
Highland
Hobart
Lockport
Crest Hill
Joliet
Homewood
Glenwood
Flossmoor
Country Club Hills
Sauk Village
Chicago Heights
Park Forest
Steger
Crete
Crown Point
Romeoville
Lemont
Plainfield
Yorkville
Oswego
Shorewood
New Lenox
Mokena
Frankfort
Manhattan
Elwood
Morris
Wilmington
Peotone
Beecher
Monee
University Park
Richton Park
South Chicago Heights
Olympia Fields
Matteson
Alton
Bethalto
East Alton
Wood River
Roxana
Saint Charles
Ferguson
Granite City
Madison
Venice
Caseyville
Belleville
Centreville
Swansea
Cahokia
East Saint Louis
Fairview Heights
Millstadt
Mascoutah
Freeburg
Waterloo
Columbia
Festus
Valmeyer
Monroe City
Maeystown
Marissa
Red Bud
Renault
Baldwin
Coulterville
Sparta
Evansville
Prairie du Rocher
Ellis Grove
Steeleville
Percy
Pinckneyville
Du Quoin
Willisville
Tamaroa
Perry
Whitewater
Mississippi River
Kaskaskia River
Illinois River
Des Plaines River
Fox River
Du Page River
Kankakee River
Whitewater River
Big Muddy River
Saline River
Ohio River
Wabash River
Green River
Tradewater River
Cumberland River
Tennessee River
Kentucky Lake
Lake Barkley
Carbondale
Cape Girardeau
Paducah
Metropolis
Mound City
Cairo
Charleston
Sikeston
Princeton
Hopkinsville
Madisonville
Henderson
Terre Haute
Vincennes
Princeton
Mount Carmel
Lawrenceville
Robinson
Effingham
Mattoon
Charleston
Litchfield
Carlinville
Jerseyville
Alton
Wood River
Edwardsville
Highland
Greenville
Vandalia
Salem
Centralia
Mount Vernon
Benton
West Frankton
Harrisburg
Marion
Carmi
Olney
Flora
Clay City
Fairfield
Albion
Grayville
Crossville
Shawneetown
Old Shawneetown
Golconda
Rosiclare
Cave-in-Rock
Elizabethtown
Eddyville
Karbers Ridge
Burnside
Stonefort
Goreville
Vienna
Jonesboro
Cobden
Anna
Makanda
Carterville
Herrin
Murphysboro
Du Quoin
Sparta
Coulterville
Waterloo
Columbia
Festus
Saint Charles
Elburn
Geneva
Batavia
Saint Charles
Sugar Grove
Yorkville
Plainfield
Oswego
Shorewood
New Lenox
Mokena
Frankfort
Manhattan
Elwood
Morris
Wilmington
Peotone
Beecher
Monee
University Park
Richton Park
South Chicago Heights
Olympia Fields
Matteson
Inset map scale
Main map scale
60 Miles
90 Kilometers
120 Miles
200 Kilometers

Illinois map index

Metropolitan areas

Bloomington-Normal 150,433
Champaign-Urbana 179,669
Chicago 8,272,768
Davenport (Ia.)-Moline-Rock Island ..... 359,062 (200,394 in Ill.; 158,668 in Ia.)
Decatur 114,706
Kankakee 103,833
Peoria-Pekin 347,387
Rockford 371,236
St. Louis (Mo.) ..... 2,603,607 (2,003,762 in Mo.; 599,845 in Ill.)
Springfield 201,437

Counties

Adams	68,277	H	4
Alexander	9,590	O	8
Bond	17,633	J	8
Boone	41,786	A	9
Brown	6,950	H	5
Bureau	35,503	C	7
Calhoun	5,084	I	5
Carroll	16,674	B	6
Cass	13,695	G	6
Champaign	179,669	G	10
Christian	35,372	J	8
Clark	17,008	I	11
Clay	14,560	K	10
Clinton	35,535	K	7
Coles	53,196	J	10
Cook	5,376,741	B	11
Crawford	20,452	J	11
Cumberland	11,253	I	10
De Kalb	88,969	B	9
De Witt	16,798	G	9
Douglas	19,922	H	10
Du Page	904,161	B	10
Edgar	19,704	H	11
Edwards	6,971	L	10
Effingham	34,264	J	9
Fayette	21,802	J	9
Ford	14,241	F	10
Franklin	39,018	M	9
Fulton	38,250	F	6
Gallatin	6,445	M	10
Greene	14,761	I	5
Grundy	37,535	D	10
Hamilton	8,621	M	9
Hancock	20,121	F	4
Hardin	4,800	N	10
Henderson	8,213	F	4
Henry	51,020	D	6
Iroquois	31,334	F	11
Jackson	59,612	M	7
Jasper	10,117	J	10
Jefferson	40,045	L	9
Jersey	21,668	J	6
Jo Daviess	22,289	A	6
Johnson	12,878	N	9
Kane	404,119	B	10
Kankakee	103,833	D	11
Kendall	54,544	C	10
Knox	55,836	E	6
Lake	644,356	A	10
La Salle	111,509	D	8
Lawrence	15,452	K	11
Lee	36,062	C	8
Livingston	39,678	E	9
Logan	31,183	G	8
Macon	114,706	H	8
Macoupin	49,019	J	6
Madison	258,941	J	7
Marion	41,691	K	9
Marshall	13,180	E	7
Mason	16,038	G	7
Massac	15,161	O	9
McDonough	32,913	G	5
McHenry	260,077	A	10
McLean	150,433	F	9
Menard	12,486	G	6
Mercer	16,957	D	5
Monroe	27,619	L	6
Montgomery	30,652	I	7
Morgan	36,616	H	6
Moultrie	14,287	I	9
Ogle	51,032	B	7
Peoria	183,433	E	7
Perry	23,094	M	7
Piatt	16,365	H	9
Pike	17,384	H	4
Pope	4,413	O	9
Pulaski	7,348	O	8
Putnam	6,086	D	8
Randolph	33,893	M	7
Richland	16,149	K	10
Rock Island	149,374	D	4
St. Clair	256,082	L	6
Saline	26,733	N	9
Sangamon	188,951	I	7
Schuyler	7,189	G	5
Scott	5,537	I	8
Shelby	22,893	I	8
Stark	6,332	D	7
Stephenson	48,979	A	7
Tazewell	128,485	F	7
Union	18,293	N	8
Vermilion	83,919	G	11
Wabash	12,937	L	11
Warren	18,735	E	5
Washington	15,148	L	7
Wayne	17,151	L	9
White	15,371	L	10
Whiteside	60,653	C	6
Will	502,266	C	10
Williamson	61,296	N	9
Winnebago	278,418	A	8
Woodford	35,469	E	9

Cities, towns, and villages

Abingdon	3,612	E	6
Addison*	35,914	B	10
Albany	895	C	6
Albers	878	K	7
Albion°	1,933	L	10
Aledo°	3,613	D	5
Alexis	863	E	5
Algonquin	23,276	K	1
Alhambra	630	K	7
Allendale	528	K	11
Alorton*	2,749	K	6
Alpha	726	D	5
Alsip	19,725	N	4
Altamont	2,283	J	9
Alton	30,496	J	6
Altona	570	D	6
Amboy	2,561	C	8
Andalusia	1,050	D	5
Andover	594	D	6
Anna	5,136	N	8
Annawan	868	D	6
Antioch	8,788	J	2
Apple River	379	A	6
Arcola	2,652	H	10
Argenta	921	H	9
Arlington Heights	76,031	L	3
Aroma Park	821	F	11
Arthur	2,203	H	9
Ashkum	724	E	11
Ashland	1,361	H	6
Ashley	613	L	8
Ashmore	809	I	10
Ashton	1,142	B	8
Assumption	1,261	I	8
Astoria	1,193	G	6
Athens	1,726	H	7
Atkinson	1,001	D	6
Atlanta	1,649	G	8
Atwood	1,290	H	9
Auburn	4,317	I	7
Augusta	657	G	4
Aurora	142,990	C	10
Ava	662	M	7
Aviston	1,231	K	7
Avon	915	F	5
Bannockburn	1,429	K	3
Barrington	10,168	K	2
Barrington Hills	3,915	K	2
Barry	1,368	H	4
Bartlett*	36,706	B	10
Bartonville	6,310	F	7
Batavia	23,866	M	1
Batestown, see Hillery [-Batestown]			
Beardstown	5,766	G	5
Beckemeyer	1,043	K	8
Bedford Park*	574	C	11
Beecher	2,033	O	4
Belgium	466	G	11
Belleville°	41,410	L	6
Bellevue	1,887	F	7
Bellwood	20,535	M	3
Belvidere°	20,820	A	9
Bement	1,784	H	9
Beold	1,541	J	7
Bensenville*	20,703	B	10
Benton°	6,880	M	9
Berkeley*	5,245	B	11
Berwyn	54,016	M	3
Bethalto	9,454	J	6
Bethany	1,287	H	9
Blandinsville	777	F	5
Bloomingdale	21,675	L	2
Bloomington°	64,808	F	8
Blue Island	23,463	N	4
Blue Mound	1,129	H	8
Bluffs	748	H	5
Bluford	785	L	9
Bolingbrook	56,321	N	2
Boulder Hill*†	8,169	C	10
Bourbonnais	15,256	D	11
Braceville	792	D	10
Bradford	787	D	7
Bradley	12,784	D	11
Braidwood	5,203	D	10
Breese	4,048	K	7
Bridgeport	2,168	K	11
Bridgeview	15,335	M	3
Brighton	2,196	J	6
Brimfield	933	E	7
Broadview*	8,264	B	11
Brookfield	19,085	M	3
Brooklyn*	676	K	6
Brookport	1,054	O	9
Brownstown	705	J	8
Buckley	593	F	10
Buda	592	D	7
Buffalo Grove	42,909	K	3
Bunker Hill	1,801	J	6
Burbank*	27,902	C	11
Burnham	4,170	N	4
Burr Ridge	10,408	M	3
Bushnell	3,221	F	5
Byron	2,917	B	8
Cahokia	16,391	K	6
Cairo°	3,632	O	8
Calumet City	39,071	N	4
Calumet Park	8,516	N	4
Cambria	1,330	M	8
Cambridge°	2,180	D	6
Camp Point	1,244	G	4
Canton	15,288	F	6
Capron	961	A	9
Carbon Cliff	1,689	C	6
Carbondale	20,681	N	8
Carlinville°	5,685	J	6
Carlyle°	3,406	K	8
Carmi°	5,422	M	10
Carol Stream	40,438	M	2
Carpentersville	30,586	L	1
Carriers Mills	1,886	N	9
Carrollton°	2,605	I	5
Carterville	4,616	N	8
Carthage°	2,725	F	4
Cary	15,531	K	2
Casey	2,942	I	11
Caseyville	4,310	K	6
Catlin	2,087	G	11
Cedarville	719	A	7
Central City	1,371	K	8
Centralia	14,136	L	8
Centreville	5,951	K	6
Cerro Gordo	1,436	H	9
Chadwick	505	B	7
Champaign	67,518	G	10
Chandlerville	704	G	6
Channahon*	7,344	D	10
Channel Lake†	1,785	J	2
Chapin	592	H	5
Charleston°	21,039	I	10
Chatham	8,583	H	7
Chatsworth	1,265	E	10
Chebanse	1,148	E	11
Chenoa	1,845	E	9
Cherry	509	D	8
Cherry Valley	2,191	A	8
Chester°	5,185	M	7
Chicago°	2,896,016	B	11
Chicago Heights	32,776	O	4
Chicago Ridge	14,127	N	3
Chillicothe	5,996	E	7
Chrisman	1,318	H	11
Christopher	2,836	M	8
Cicero	85,616	M	4
Cisne	673	K	10
Cissna Park	811	F	11
Clarendon Hills*	7,610	C	10
Clay City	1,000	K	10
Clayton	904	G	4
Clifton	1,317	E	11
Clinton°	7,485	G	8
Coal City	4,797	D	10
Coal Valley	3,606	D	5
Cobden	1,116	N	8
Coffeen	709	J	8
Colchester	1,493	F	5
Colfax	989	F	9
Collinsville	24,707	K	6
Colona	5,173	D	6
Columbia	7,922	L	6
Cordova	633	C	6
Cornell	511	E	9
Cortland	2,066	B	9
Coultervile	1,230	L	7
Country Club Hills	16,169	O	4
Countryside*	5,991	C	11
Cowden	612	J	9
Crainville	992	N	8
Creal Springs	702	N	9
Crescent City	631	E	11
Crest Hill	13,329	O	2
Crestwood*	11,251	C	11
Crete	7,346	O	4
Creve Coeur	5,448	F	7
Crossville	782	L	10
Crystal Lake	38,000	K	1
Cuba	1,418	F	6
Cullom	563	E	10
Dakota	499	A	7
Dallas City	1,055	F	4
Dalton City	581	H	9
Dalzell	717	D	8
Danforth	587	E	10
Danvers	1,183	F	8
Danville°	33,904	G	11
Darien*	22,860	C	10
Davis	662	A	7
Decatur°	81,860	H	8
Deer Creek	605	F	8
Deer Park*	3,102	B	10
Deerfield	18,420	K	3
De Kalb	39,018	B	9
Delavan	1,825	F	7
De Pue	1,842	D	8
De Soto	1,653	M	8
Des Plaines	58,720	L	3
Diamond	1,393	D	10
Diamund Lake*		A	10
Dieterich	591	J	10
Divernon	1,201	I	7
Dixmoor*	3,934	C	11
Dixon°	15,941	C	7
Dolton	25,614	N	4
Dongola	806	O	8
Downers Grove	48,724	M	2
Downs	776	F	9
Dunlap	926	E	7
Dupo	3,933	L	6
Du Quoin	6,448	M	8
Durand	1,081	A	8
Dwight	4,363	E	10
Earlville	1,778	C	8
East Alton	6,830	K	6
East Cape Girardeau*	437	O	7
East Carondelet	267	K	6
East Dubuque	1,995	A	5
East Dundee	2,955	L	2
East Galesburg	839	E	6
East Hazel Crest*	1,607	C	11
East Moline	20,333	C	5
East Peoria	22,638	F	7
East St. Louis	31,542	K	6
Eddyville	153	N	9
Edgewood	527	J	9
Edinburg	1,135	H	8
Edwardsville°	21,491	K	6
Effingham°	12,384	J	9
Eileen		D	10
Elburn	2,756	M	1
Eldorado	4,534	M	10
Elgin	94,487	B	10
Elizabeth	682	A	6
Elizabethtown°	348	N	10
Elk Grove Village	34,727	L	3
Elkville	1,001	M	8
Elmhurst	42,762	M	3
Elmwood	1,945	E	6
Elmwood Park	25,405	M	3
El Paso	2,695	F	8
Elsah	635	J	6
Elwood	1,620	D	10
Energy	1,175	N	8
Enfield	625	M	10
Equality	721	N	10
Erie	1,589	C	6
Eureka°	4,871	F	8
Evanston	74,239	L	4
Evansville	724	M	6
Evergreen Park	20,821	N	4
Fairbury	3,968	F	9
Fairfield°	5,421	L	10
Fairmont City	2,436	K	6
Fairmount	640	G	11
Fairview	493	F	6
Fairview Heights*	15,034	K	6
Farina	558	K	9
Farmer City	2,055	G	9
Farmersville	768	I	7
Farmington	2,601	F	6
Findlay	723	I	9
Fisher	1,647	G	10
Fithian	506	G	11
Flanagan	1,083	E	9
Flora	5,086	K	9
Flossmoor	9,301	O	4
Ford Heights	3,456	O	4
Forest Home*		K	6
Forest Lake*†	1,530	A	10
Forest Park*	15,688	B	11
Forest View*	778	C	11
Forrest	1,225	E	10
Forreston	1,469	B	7
Forsyth	2,434	H	8
Fox Lake	9,178	J	2
Fox Lake Hills*†	2,561	A	10
Fox River Grove	4,862	K	2
Fox River Valley Gardens*	788	A	10
Frankfort	10,391	O	3
Franklin	586	I	6
Franklin Grove	1,052	C	8
Franklin Park	19,434	M	3
Freeburg	3,872	L	6
Freeport°	26,443	A	7
Fulton	3,881	B	6
Gages Lake*†	10,415	J	2
Galatia	1,013	M	9
Galena°	3,460	A	5
Galesburg°	33,706	E	6
Galva	2,758	D	6
Gardner	1,406	D	10
Geneseo	6,480	D	6
Geneva°	19,515	B	10
Genoa	4,169	B	9
Georgetown	3,628	H	11
Germantown	1,118	K	7
Gibson City	3,373	F	10
Gifford	815	G	10
Gillespie	3,412	J	7
Gilman	1,793	E	10
Girard	2,245	I	7
Glasford	1,076	F	7
Glen Carbon	10,425	K	6
Glen Ellyn	26,999	M	2
Glencoe	8,762	K	4
Glendale Heights*	31,765	B	10
Glenview	41,847	L	3
Glenwood	9,000	O	4
Golconda°	726	O	10
Golden	629	G	4
Goreville	938	N	9
Grafton	609	J	5
Grand Ridge	546	D	9
Grand Tower	624	N	7
Grandview	1,537	H	7
Granite City	31,301	K	6
Grant Park	1,358	D	11
Granville	1,414	D	8
Grass Lake		J	2
Grayslake	18,506	J	2
Grayville	1,725	L	11
Green Oaks	3,572	K	3
Green Rock		D	6
Green Valley	728	F	7
Greenfield	1,179	I	6
Greenup	1,532	J	10
Greenview	862	G	7
Greenville	6,955	J	8
Gridley	1,411	F	9
Griggsville	1,258	H	5
Gurnee	28,834	J	3
Hamilton	3,029	F	3
Hammond	518	H	9
Hampshire	2,900	B	9
Hampton	1,626	C	5
Hanna City	1,013	F	7
Hanover	836	A	6
Hanover Park*	38,278	B	10
Hardin°	959	J	5
Harrisburg°	9,860	N	9
Harristown	1,338	H	8
Hartford	1,545	K	6
Harvard	7,996	A	9
Harvey	30,000	N	4
Harwood Heights	8,297	L	3
Havana°	3,577	G	6
Hawthorn Woods	6,002	K	2
Hazel Crest	14,816	N	4
Hebron	1,038	A	9
Hegeler*		G	11
Hennepin°	707	D	8
Henry	2,540	E	8
Herrin	11,298	M	8
Herscher	1,523	E	10
Heyworth	2,431	G	8
Hickory Hills	13,926	N	3
Highland	8,438	K	7
Highland Park	31,365	K	3
Highwood	4,143	K	3
Hillcrest	1,158	B	8
Hillery [-Batestown]*		G	11
Hillsboro°	4,359	J	7
Hillsdale	588	C	6
Hillside*	8,155	B	11
Hinckley	1,994	C	9
Hinsdale	17,349	M	3
Hodgkins	2,134	M	3
Hoffman Estates	49,495	L	2
Holiday Hills*	831	A	10
Homer	1,200	G	11
Hometown	4,467	N	4
Homewood	19,543	O	4
Hoopeston	5,965	F	11
Hopedale	929	F	8
Hoyleton	520	L	8
Hudson	1,510	F	8
Hull	474	H	4
Huntley	5,730	K	1
Hurst	805	M	8
Hutsonville	568	J	11
Illiopolis	916	H	8
Indian Head Park*	3,685	C	11
Industry	540	G	5
Ingleside*		A	10
Inverness*	6,749	B	10
Ipava	506	G	6
Irving	2,484	J	8
Irvington	736	L	8
Island Lake	8,153	K	2
Itasca*	8,302	B	10
Jacksonville°	18,940	H	6
Jerome	1,414	H	7
Jerseyville°	7,984	J	6
Johnston City	3,557	M	9
Joliet°	106,221	C	10
Jonesboro°	1,853	N	8
Justice	12,193	N	3
Kankakee°	27,491	D	11
Kansas	842	I	11
Karnak	619	O	9
Keithsburg	714	E	4
Kenilworth	2,494	L	4
Kewanee	12,944	D	6
Kildeer	3,460	K	2
Kincaid	1,441	I	8
Kingston	980	B	9
Kinmundy	892	K	9
Kirkland	1,166	B	9
Kirkwood	794	F	5
Knoxville	3,183	E	6
Lacon°	1,979	E	8
Ladd	1,313	D	8
La Grange	15,608	M	3
La Grange Park	13,295	M	3
La Harpe	1,385	F	4
Lake Barrington	4,757	K	2
Lake Bluff	6,056	K	3

Lake Catherine*† ...1,490 ..A 10
Lake Forest ....20,059 ..K 3
Lake in the Hills* .....23,152 ..B 10
Lake of the Woods*† .....3,026 ..G 10
Lake Villa .....5,864 ..J 2
Lake Zurich ....18,104 ..K 2
Lakemoor .....2,788 ..J 2
Lakewood .....2,337 ..K 1
La Moille .....773 ..C 8
Lanark .....1,584 ..B 7
Lansing .....28,332 ..O 4
La Salle .....9,796 ..D 8
Latham .....371 ..H 8
Lawrenceville° .....4,745 ..K 11
Leaf River .....555 ..B 7
Lebanon .....3,523 ..K 7
Leland .....970 ..C 9
Leland Grove ....1,592 ..H 7
Lemont .....13,098 ..N 3
Lena .....2,887 ..A 7
Le Roy .....3,332 ..G 9
Lewistown° .....2,522 ..F 6
Lexington .....1,912 ..F 9
Liberty .....519 ..H 4
Libertyville ....20,742 ..K 3
Lincoln° .....15,369 ..G 8
Lincolnshire ....6,108 ..K 3
Lincolnwood ....12,359 ..L 4
Lindenhurst ....12,539 ..J 2
Lisle* .....21,182 ..C 10
Litchfield .....6,815 ..J 7
Livingston .....825 ..J 7
Loami .....804 ..H 7
Lockport .....15,191 ..N 2
Lomax .....477 ..F 4
Lombard .....42,322 ..M 3
London Mills .....447 ..F 6
Long Grove .....6,735 ..K 3
Long Lake† .....3,356 ..J 2
Lostant .....486 ..D 8
Louisville° .....1,242 ..K 9
Loves Park .....20,044 ..A 8
Lovington .....1,222 ..H 9
Lyndon .....566 ..C 6
Lynwood* .....7,377 ..C 11
Lyons .....10,255 ..M 3
Mackinaw .....1,452 ..F 8
Macomb° .....18,558 ..F 5
Macon .....1,213 ..H 8
Madison .....4,545 ..K 6
Mahomet .....4,877 ..G 10
Malta .....969 ..B 9
Manhattan .....3,330 ..O 3
Manito .....1,733 ..F 7
Mansfield .....949 ..G 9
Manteno .....6,414 ..D 11
Maple Park .....765 ..B 9
Marengo .....6,355 ..A 9
Marine .....910 ..K 7
Marion° .....16,035 ..N 9
Marissa .....2,141 ..L 7
Markham .....12,620 ..N 4
Maroa .....1,654 ..G 8
Marquette Heights* .....2,794 ..F 7
Marseilles .....4,655 ..D 9
Marshall° .....3,771 ..I 11
Martinsville .....1,225 ..I 11
Maryville .....4,651 ..K 6
Mascoutah .....5,659 ..L 7
Mason City .....2,558 ..G 7
Matherville .....772 ..D 5
Matteson .....12,928 ..O 4
Mattoon .....18,291 ..I 10
Maywood .....26,987 ..M 3
Mazon .....904 ..D 9
McCullom Lake .....1,038 ..J 1
McHenry .....21,501 ..J 1
McLean .....808 ..G 8
McLeansboro° .....2,945 ..M 9
Meadowbrook* .....K 6
Melrose Park ...23,171 ..M 3
Mendon .....883 ..G 4
Mendota .....7,272 ..C 8
Meredosia .....1,041 ..H 5
Merrionette Park* .....1,999 ..C 11
Metamora .....2,700 ..E 8
Metropolis° .....6,482 ..O 9
Midlothian .....14,315 ..N 4
Milan .....5,348 ..D 5
Milford .....1,369 ..F 11
Milledgeville ....1,016 ..B 7
Millstadt .....2,794 ..L 6
Minier .....1,244 ..F 8
Minonk .....2,168 ..E 8
Minooka .....3,971 ..O 2
Mokena .....14,583 ..O 3
Moline .....43,768 ..C 5
Momence .....3,171 ..D 11
Monee .....2,924 ..O 4
Monmouth° .....9,841 ..E 5
Montgomery ....5,471 ..N 1
Monticello° .....5,138 ..G 9
Morris° .....11,928 ..D 10
Morrison° .....4,447 ..C 6
Morrisonville ....1,068 ..I 7
Morristown .....B 8
Morton .....15,198 ..F 7
Morton Grove .....22,451 ..L 3
Moond City° .....692 ..O 8
Mounds .....1,117 ..O 8
Mount Auburn ....515 ..H 8
Mount Carmel° .....7,982 ..L 11
Mount Carroll° ....1,832 ..B 6
Mount Morris ....3,013 ..B 7
Mount Olive ....2,150 ..J 7
Mount Prospect ....56,265 ..L 3
Mount Pulaski ....1,701 ..G 8
Mount Sterling° .....2,070 ..H 5
Mount Vernon° .....16,269 ..L 9
Mount Zion .....4,845 ..H 9
Moweaqua .....1,923 ..H 8
Mulberry Grove ...671 ..J 8
Mundelein .....30,935 ..K 3
Murphysboro° .....13,295 ..N 8
Murrayville .....644 ..J 6
Naperville .....128,358 ..M 2
Naplate .....523 ..D 9
Nashville° .....3,147 ..L 8
Nauvoo .....1,063 ..F 3
Neoga .....1,854 ..I 10
Neponset .....519 ..D 7
New Athens .....1,981 ..L 7
New Baden .....3,001 ..K 7
New Berlin .....1,030 ..H 6
New Boston .....632 ..D 4
New Haven .....477 ..M 10
New Lenox .....17,771 ..O 3
Newark .....887 ..C 9
Newman .....956 ..H 11
Newton° .....3,069 ..J 10
Niantic .....738 ..H 8
Niles .....30,068 ..L 3
Noble .....746 ..K 10
Nokomis .....2,389 ..I 8
Normal .....45,386 ..F 8
Norridge .....14,582 ..L 3
Norris City .....1,057 ..M 10
North Aurora ...10,585 ..M 1
North Barrington ....2,918 ..K 2
North Chicago .....35,918 ..K 3
North Park* .....A 8
North Pekin .....1,574 ..F 7
North Riverside* .....6,688 ..B 11
North Utica .....977 ..D 8
Northbrook .....33,435 ..L 3
Northfield* .....5,389 ..B 11
Northlake .....11,878 ..M 3
Norwood .....473 ..F 7
Oak Brook* .....8,702 ..C 10
Oak Forest .....28,051 ..N 4
Oak Grove .....1,318 ..D 5
Oak Lawn .....55,245 ..N 4
Oak Park .....52,524 ..M 3
Oakbrook Terrace* .....2,300 ..B 10
Oakland .....996 ..H 10
Oakwood .....1,502 ..G 11
Oakwood Hills ...2,194 ..K 2
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*Does not appear on map; key shows general location.
†Census designated place—unincorporated, but recognized as a significant settled community by the U.S. Census Bureau.
°County seat.
Places without population figures are unincorporated areas.
Source: 2000 census.

The fine recreation facilities of Illinois attract millions of visitors each year. Picnickers, hikers, and bicycle riders enjoy Cook County's forest preserves and lakefront. Hunters shoot deer, pheasants, quail, rabbits, and turkeys in Illinois's hunting grounds. Lake Michigan and many smaller lakes throughout the state are popular for boating, fishing, and swimming. The Mississippi, Ohio, and Wabash rivers, along the borders of Illinois, are major recreation sites. The Shawnee Hills of southern Illinois and the rolling hills of Jo Daviess County in northwestern Illinois have beautiful scenery.

Chicago's central location and its many fine hotels, restaurants, and municipal auditoriums make it a leading convention city. Sandy beaches, wooded parks, and yacht harbors border most of Chicago's 30-mile (48-kilometer) shoreline along Lake Michigan.

Other Chicago attractions include two major league baseball teams, the Cubs of the National League and the White Sox of the American League. The city has a professional hockey team, the Blackhawks of the National Hockey League. Chicago also has a professional National Football League team, the Bears; and a professional National Basketball Association team, the Bulls.

Two state fairs—in Springfield during August and in Du Quoin in late August through early September—are among the most popular annual events in Illinois. The fairs feature automobile races, agricultural exhibits, performances by entertainers, and other attractions.

Places to visit

Following are brief descriptions of some of Illinois's most interesting places to visit.

Abraham Lincoln's home, in Springfield, is a national historic site. Lincoln and his family lived in the white frame house from 1844 to 1861.

Bishop Hill, near Galva, is the site of a religious community founded in 1846 by Swedish settlers led by Eric Janson. These settlers owned all property in common. Several old buildings still stand. Bishop Hill also has a collection of American primitive paintings. It has been a state memorial since 1947.

Black Hawk statue stands by the Rock River near Oregon in Lowden Memorial State Park. Lorado Taft made the statue, which honors the Indians of the valley. The statue was completed in 1911.

Brookfield Zoo, officially the Chicago Zoological Park, is one of the nation's finest zoos. Visitors may see rare animals from all over the world. An interesting feature is the use of moats rather than bars to separate the animals from visitors.

Cahokia Mounds, near Collinsville, includes Monk's Mound, the largest known Indian mound in the United States.

Chicago has cultural and sporting events, museums, trade shows, and conventions that attract about 15 million visitors a year. For further information, see **Chicago**.

Illinois and Michigan National Heritage Corridor is a historic area that stretches from Chicago to LaSalle-Peru. It lies along the site of a canal that was used from 1848 until the early 1900's. Attractions include recreational facilities, historical displays, and demonstrations of how canal locks work.

Lincoln's New Salem State Historic Site has a reproduction of the town in which Abraham Lincoln lived from 1831 to 1837. Its buildings include the old *cooper's* (barrelmaker's) shop where Lincoln studied at night, and the tavern and store of which he was part owner. The park was established northwest of Springfield in 1919.

Morton Arboretum, near Lisle, covers about 700 acres (280 hectares) and has about 5,000 kinds of trees and plants.

Nauvoo was founded as a Mormon community by Joseph Smith along the Mississippi River in 1839. Visitors may see homes of Smith and of Brigham Young and Wilford Woodruff, two of the Twelve Apostles of the Mormon Church.

Ulysses S. Grant home, in Galena, is furnished much as it was when Grant lived in it. The house, built in 1857, has been a state historic site since 1932.

Vandalia State House, an attractive colonial structure, was the state capitol building from 1836 to 1839. Abraham Lincoln served as state representative in Vandalia. The Vandalia State House became a state memorial in 1920.

State and national forests. Illinois has five state forests—Big River, Hidden Springs, Sand Ridge, Louden-Miller, and Trail of Tears. The Shawnee National Forest stretches across nine counties in southern Illinois. The state also has the Middle Fork National Scenic River, in the Danville area.

State parks. Illinois has 73 state parks, 38 state memorials, and 39 conservation areas. For information on state parks and memorials, write to the Illinois Department of Conservation, Bureau of Lands and Historic Sites, 524 South Second, Springfield, IL 62701.

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Dolphins performing at Brookfield Zoo near Chicago

© George Mars Cassidy, Click/Chicago

Illinois State Fair in Springfield

Steve Leonard, Click/Chicago

The Art Institute of Chicago

Annual events

January-March

Boat and Sports Show at McCormick Place in Chicago (January); Central Illinois Jazz Festival in Decatur (January); Annual Groundhog Days Celebration in Woodstock (February); St. Patrick's Day Parade in Chicago (mid-March).

April-June

Old Capitol Art Fair in Springfield (May); PP6 Indy Car World Series in Madison (May); Galena House Tours Festival (June); Old Town Art Fair in Chicago (June); Fort de Chartres Rendezvous in Prairie du Rocher (June); Steamboat Days and Race in Peoria (mid-June); Taste of Chicago at Grant Park in Chicago (late June to early July); Ravinia Music Festival in Highland Park (late June to mid-September).

July-September

Illinois State Fair in Springfield (August); Chicago Jazz Festival (early September); Du Quoin State Fair and World Trotting Derby (Labor Day weekend); Grape Festival in Nauvoo (Labor Day weekend); Apple Festival in Long Grove (September); Jordbruksdagarna (Swedish Agricultural Days) in Bishop Hill (September).

October-December

Pumpkin Festival in Sycamore (October); Spoon River Scenic Drive Fall Festival in Fulton County (October); Scarecrow Festival in St. Charles (October); Christmas Around the World Display at the Museum of Science and Industry in Chicago (November-December); Lake Shelbyville Festival of Lights (November-January).

Nauvoo Restoration

A pottery-making demonstration at Nauvoo

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Galena, in scenic Jo Daviess County

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Ravinia Music Festival in Highland Park

© Kent and Donna Dannen, Photo Researchers

Lincoln's New Salem State Historic Site near Springfield

Land regions. Illinois has five main land regions: (1) the Till Plains, (2) the Driftless Area, (3) the Great Lakes Plains, (4) the Shawnee Hills, and (5) the Gulf Coastal Plain.

The Till Plains cover most of Illinois. They are part of the fertile Interior Plains that extend across much of the Midwestern States. During the Ice Age, glaciers brought in materials that became soil and leveled most of the surface of this region (see Ice age). This action produced a gently rolling plain in most of what is now Illinois. Much of this plain was covered with prairie grass, which enriched the soil as it died and decayed. Today, the fertile black soil of the Till Plains makes this section the state's most important farming area. The section is sometimes called the *Garden Spot of the Nation.* It is part of the Corn Belt that extends westward from Ohio to Kansas and Nebraska.

A part of the Till Plains was not touched by glaciers. This section lies between the Illinois and Mississippi rivers in Calhoun and Pike counties, in the west-central part of the state. Streams, ridges, and small hills break up this area. Orchards of apples and other fruits cover many of the slopes. Grain and hay are the chief crops.

The Driftless Area, which covers most of Jo Daviess County in northwestern Illinois, is another section of the state that was not touched by glaciers. The Driftless Area has the state's tallest hills and deepest valleys. Charles Mound (1,235 feet, or 376 meters), near Apple River, is the highest point in Illinois.

The Great Lakes Plains cover the northeastern corner of Illinois. This section is the industrial and shipping region around Chicago. Lake Michigan once covered this area, which is now level with fertile soil. Small hills, lakes, and marshes appear north and west of the Chicago area.

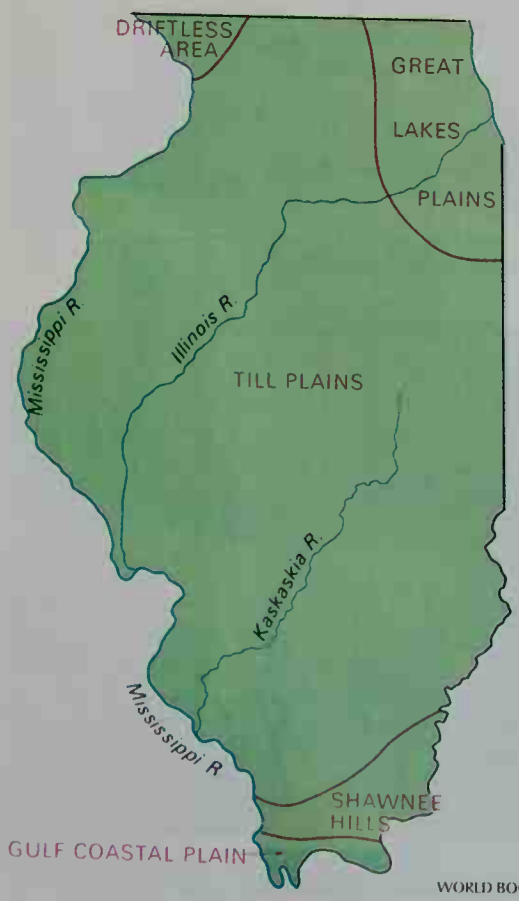
The Shawnee Hills, sometimes called the *Illinois Ozarks,* stretch across the southern part of the state for about 70 miles (110 kilometers). The width of the area varies from 5 to 40 miles (8 to 64 kilometers). The land ranges from 300 to 1,065 feet (91 to 325 meters) above sea level. It is a region of valleys, woods, river bluffs, and forested hills. Orchards thrive on many of the hills in this region of Illinois.

The Gulf Coastal Plain of Illinois is the northern end of the plain that extends northward through the United States from the Gulf of Mexico. In Illinois, it covers the southern tip of the state. The northern part of this region is hilly, and the southern part is flat. Early settlers nicknamed this region *Egypt,* probably because the land between the Mississippi and Ohio rivers looks like the Nile Delta in Egypt. The lowest part of the state, which is 279 feet (85 meters) above sea level, lies in this area, along the Mississippi River.

Shoreline. Illinois has 63 miles (101 kilometers) of shoreline on Lake Michigan. The gently curving shore does not provide any large natural harbors in Illinois. Several artificial harbors lie along the lakefront. The largest of these harbors are at Chicago and Waukegan. The land along the Illinois shore is mostly flat, and it includes many sandy beaches.

Rivers and lakes. About 500 rivers and streams drain Illinois. The Mississippi River forms the entire western

Land regions of Illinois



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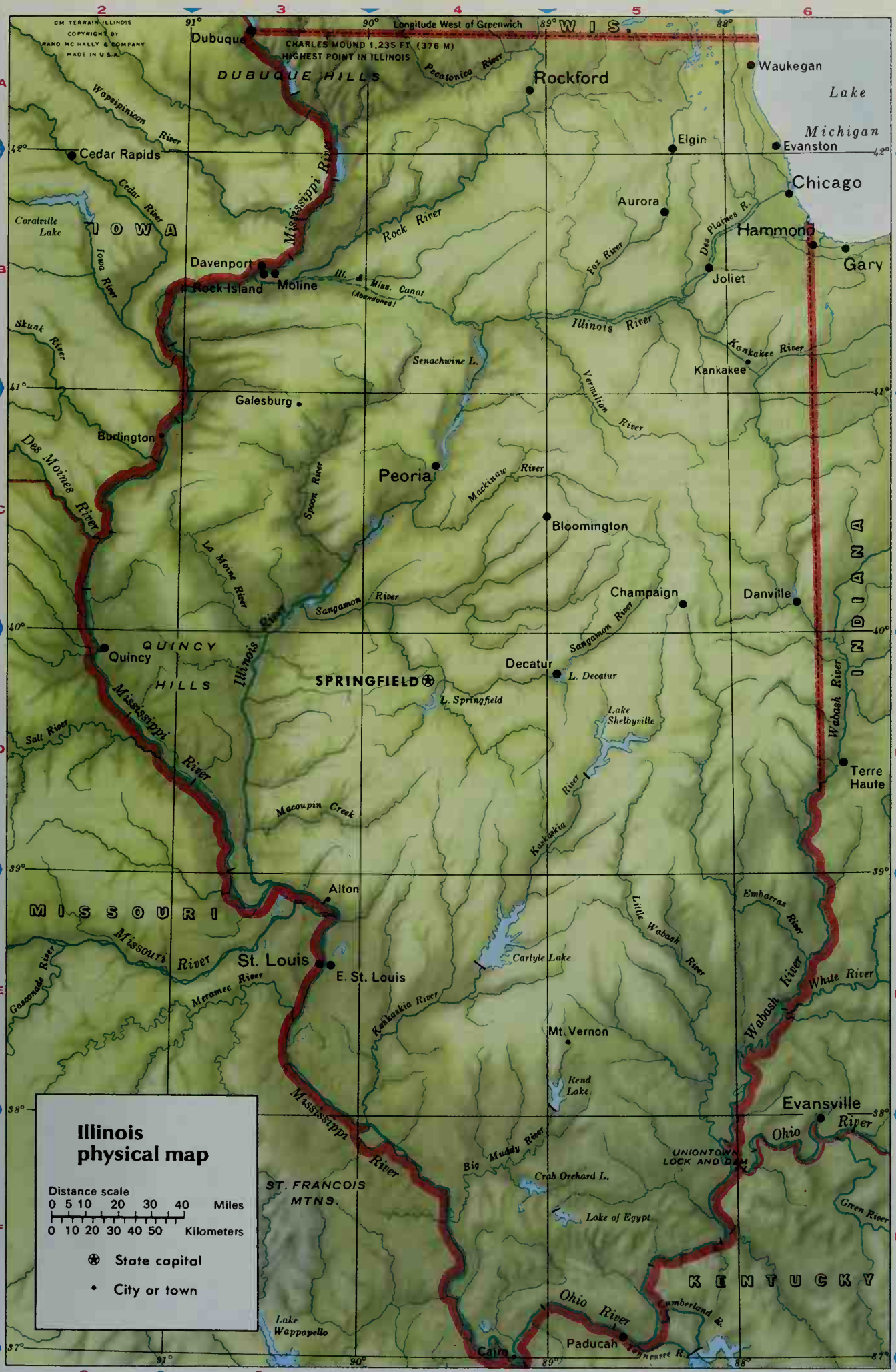
Rugged cliffs at Giant City State Park, near Carbondale, form part of the Shawnee Hills region of southern Illinois.



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border of the state. The Illinois Waterway links Lake Michigan with the Mississippi River. This waterway includes the Chicago, Des Plaines, and Illinois rivers, plus a few canals.

The Illinois River, which is 273 miles (439 kilometers) long, is the largest river entirely within the state. With its branches, it drains about half of Illinois. The Sangamon River flows past Springfield to join the Illinois. The Spoon River, another tributary of the Illinois, was made famous by the poet Edgar Lee Masters in his *Spoon River Anthology.* The Rock and Fox rivers are known for their beautiful valleys.

The Wabash River flows along part of Illinois' southeastern border. No part of the Ohio River is actually in Illinois, because the Kentucky boundary runs along the north shore of the river.

Lake Michigan forms the northeastern border of Illinois. Chain O'Lakes, a small group of lakes in northeastern Illinois, is a popular summer-resort area. It includes Fox Lake and also Grass Lake, which is covered in summer with blossoms of the American lotus.

Many Illinois counties have artificial lakes, ponds, and reservoirs. The largest artificial lake, Carlyle Lake, covers about 26,000 acres (10,500 hectares). Other large artificial lakes include Rend Lake and Crab Orchard Lake. Artificial lakes at Bloomington, Decatur, and Springfield supply water for these cities.

Plant and animal life. Forests cover about 10 per cent of Illinois. Most of the forests are in the southern part of the state or along rivers and streams. Important trees include cottonwoods, hickories, maples, oaks, and walnuts. Common wild flowers are bloodroot, dogtooth violets, Dutchman's-breeches, and toothwort.

Animals in Illinois include beavers, deer, gray and red foxes, minks, muskrats, opossums, rabbits, raccoons, squirrels, and skunks. Game birds include ducks, geese, pheasants, and quail. One of the major feeding and resting grounds for wild ducks in North America is the Illinois River valley. There, about 2 million ducks may fly in during the spring and fall migrations. Several hundred thousand Canada geese spend the winter at bird sanctuaries on lakes in southern Illinois. The state also provides waterfowl sanctuaries along the Illinois and Mississippi rivers, and at Grass Lake in northeastern Illinois. Bass, buffalo fish, carp, catfish, perch, pike, and sunfish are among the fishes found in Lake Michigan and in the smaller lakes, rivers, and streams of Illinois.

Climate. The weather of Illinois varies greatly from season to season, with cold winters and hot summers.

Average monthly weather

Chicago	Temperatures F°		Temperatures C°		Days of rain or snow
	High	Low	High	Low	
Jan.	33	17	1	−8	10
Feb.	35	20	2	−7	10
Mar.	45	29	7	−2	12
Apr.	58	39	14	4	13
May	70	49	21	9	12
June	80	59	27	15	10
July	85	64	29	18	9
Aug.	83	62	28	17	8
Sept.	76	55	24	13	8
Oct.	64	44	18	7	7
Nov.	48	31	9	−1	10
Dec.	35	21	2	−6	10

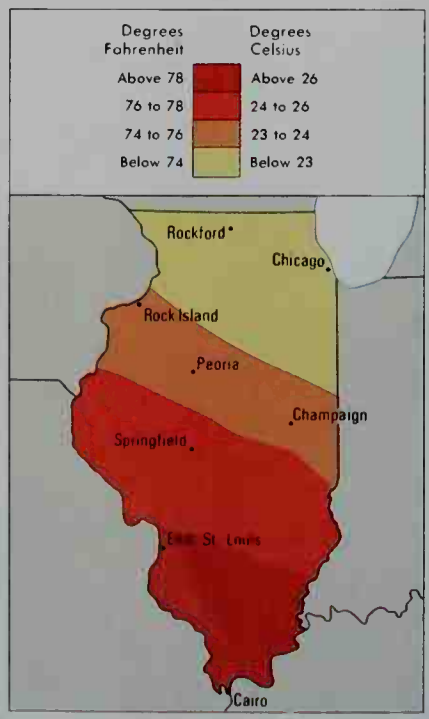
Cairo	Temperatures F°		Temperatures C°		Days of rain or snow
	High	Low	High	Low	
Jan.	45	30	7	−1	11
Feb.	48	33	9	1	10
Mar.	58	40	14	4	12
Apr.	69	51	21	11	12
May	78	59	26	15	12
June	87	68	31	20	10
July	91	72	33	22	9
Aug.	89	70	32	21	7
Sept.	82	64	28	18	8
Oct.	72	52	22	11	7
Nov.	57	40	14	4	9
Dec.	47	32	8	0	9

Average January temperatures

Illinois has cold winters. However, temperatures in the south are somewhat higher than those in the north.

Average July temperatures

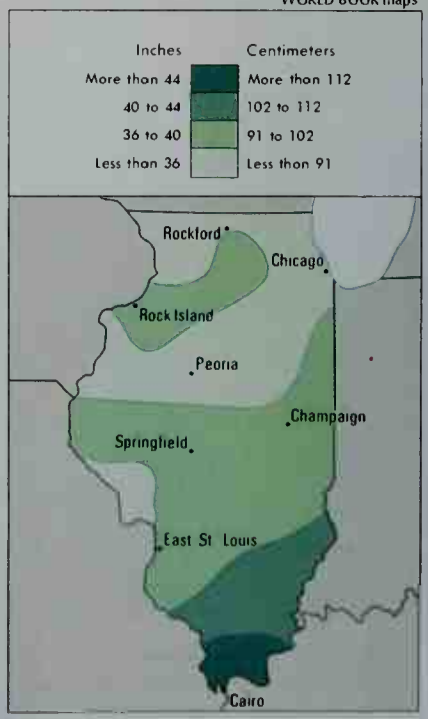
Summers are hot in southern Illinois and warm in the north. Lake Michigan cools winds in the north.



Average yearly precipitation

Winds from the Gulf of Mexico bring most of Illinois' rain. The south gets more rain, and the north more snow.

WORLD BOOK maps



Illinois State Natural History Survey

The Illinois River Valley is a major feeding and resting ground for waterfowl. About 2 million waterfowl may fly in during their spring and fall migrations.

The weather also may change sharply from day to day, especially in winter. Sometimes the temperature changes as much as 20 °F (11 °C) in an hour. These rapid changes in temperature are caused by winds that can sweep into the state from any direction, without mountains to block them.

The coldest part of Illinois is the north, which has an average January temperature of 25 °F (−4 °C) and an average July temperature of 75 °F (24 °C). Southern Illinois averages 36 °F (2 °C) in January and 79 °F (26 °C) in July. The lowest temperature ever recorded in Illinois, −36 °F (−38 °C), occurred at Congerville on Jan. 5, 1999. The highest temperature was 117 °F (47 °C), at East St. Louis on July 14, 1954.

Rainfall and snowfall vary within Illinois. Winds from the Gulf of Mexico bring most of the rainfall and snowfall. Southern Illinois averages 40 inches (100 centimeters) of precipitation a year, and northern Illinois has about 34 inches (86 centimeters) a year. The northern part of Illinois has about 30 inches (76 centimeters) of snow a year, and southern Illinois gets about 10 inches (25 centimeters).

In northern Illinois, Lake Michigan influences Chicago area weather. The lake warms winds during winter and cools them in summer. Tornadoes have killed more people in Illinois than in any other state. The most destructive tornado, in March 1925, killed 606 people near Murphysboro.

Economy

Illinois has a diverse economy. Its access to Lake Michigan and the Mississippi River help make Illinois a leading transportation center. Illinois is also one of the nation's leading manufacturing states. Service industries thrive in the state's urban areas, especially in the Chicago area. Millions of tourists visit Illinois each year and contribute more than $20 billion to the economy. Rich soil helps Illinois farmers make the state a leader in agricultural production.

Natural resources. The state's most important natural resource is its fertile soil. Illinois also has valuable mineral deposits, including coal and petroleum.

Soil. By the end of the most recent ice age about 11,500 years ago, glaciers had left a thick layer of material that became rich soil. This soil became even richer as prairie grass died and decayed for thousands of years before the first settlers arrived.

Minerals. The state's deposits of *bituminous* (soft) coal are its most important mineral resource. Coal beds lie under about two-thirds of the state. The richest coal deposits are in southern Illinois. The state also has deposits of *peat,* the first stage in nature's formation of coal. The chief peat deposits are located in the lake and swamp regions of northeastern Illinois.

Illinois also has large reserves of petroleum. The largest deposits are in the southeastern part of the state.

Large quantities of clay, gravel, limestone, sand, and sandstone are found in various parts of the state. Large deposits of silica sand lie near Ottawa. Alexander County has large reserves of *tripoli,* a chalky mineral used as a polishing powder for metal and glass.

Service industries account for the largest portion of the Illinois *gross state product*—the total value of goods and services produced within the state in a year. The state's service industries are concentrated in the metro-

Production and workers by economic activities

Economic activities	Percent of GSP* produced	Employed workers	
		Number of people	Percent of total
Community, business, & personal services	22	2,278,000	32
Finance, insurance, & real estate	20	635,500	9
Manufacturing	17	996,100	14
Wholesale & retail trade	16	1,512,500	21
Government	10	869,300	12
Transportation, communication, & utilities	10	392,400	5
Construction	4	345,200	5
Agriculture	1	163,000	2
Mining	†	20,500	†
Total	100	7,212,500	100

*GSP = gross state product, the total value of goods and services produced in a year.
†Less than one-half of 1 percent.
Figures are for 1998.
Source: *World Book* estimates based on data from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics

politan areas—especially the Chicago metropolitan area.

Community, business, and personal services contribute more to the gross state product and employ more people than any other industry group. Community, business, and personal services include such economic activities as private health care, hotels, law firms, and repair shops. Downtown Chicago is home to such business services as accounting firms, advertising agencies, engineering companies, and law firms, as well as many large hotels. Chicago's Rush-Presbyterian-St. Luke's Medical Center is one of the largest medical complexes in the world.

The finance, insurance, and real estate industry group is the next most important service industry, in terms of contributions to the gross state product. Real estate provides the most income in this industry group. Rapid population growth in suburban areas of Chicago has led to the development of many new homes and businesses there. The buying and renting of housing is an important economic activity in all urban areas of Illinois.

Economy of Illinois

This map shows the economic uses of land in Illinois and where the state's leading farm and mineral products are produced. Major manufacturing centers are shown in red.

© Lee Balterman from Marilyn Gartman

The Chicago Mercantile Exchange is a center for the trading of large quantities of farm products. The exchange ranks as the world's busiest market for buying and selling perishable commodities.

Chicago is the financial capital of the Midwest. One of the nation's largest banking companies, Bank One Corporation, is headquartered in the city. Large financial establishments called *commodities exchanges* are also in downtown Chicago. Commodities are basic goods that are bought and sold, such as grains and precious metals. The Chicago Board of Trade is the largest commodities exchange in the world. Traders there buy and sell contracts for corn, soybeans, and other commodities. Traders at the Chicago Mercantile Exchange handle contracts for cattle, eggs, hogs, and other commodities. Large investment and insurance firms are also based in Illinois. These companies include Allstate, Household International, Kemper, and State Farm.

Wholesale and retail trade rank third among the service industries. The wholesale trade of food products, hardware and machinery, motor vehicles, and petroleum products is important in Illinois. Ace Hardware, a large wholesale hardware distributor, has its headquarters in Oak Brook. Major types of retail businesses include automobile dealerships, department stores, drugstores, and food stores. The Chicago area is the home of Sears Roebuck, one of the largest retail companies in the United States. Other important retailers based in the Chicago area include McDonald's and Walgreen.

Ranking next are (1) government and (2) transportation, communication, and utilities. Each of these industry groups contributes equally to the gross state product.

Government services include the operation of public schools, public hospitals, and military bases. The public school system is a major employer in Illinois. State government offices are based mainly in Springfield and Chicago. Great Lakes Naval Base, near North Chicago, is one of the world's largest military bases.

Chicago is one of the world's leading transportation centers. One of the largest U.S. airlines, United, is headquartered near O'Hare International Airport. The Illinois Central, a major railroad, is based in Chicago. Large trucking and shipping companies are also based in the Chicago area.

The largest communications company in Illinois is Ameritech, a telecommunications business that is part of SBC Communications. The state's largest utility companies are Commonwealth Edison of Chicago and Nicor Gas of Naperville. Additional information about transportation and communication appears later in this section.

Manufacturing. Illinois is among the leading states in manufacturing. Goods produced in the state have an annual *value added by manufacture* of about $95 billion. This figure represents the increase in value of raw materials after they become finished products. The Chicago area is the nation's second-ranking manufacturing region, after the Los Angeles area.

Machinery is the leading manufactured product in Illinois in terms of value added by manufacture. Construction equipment, farm machinery, and machine tools provide much of the income for this industry. Caterpillar, a company that ranks among the world's major manufacturers of construction equipment, is headquartered in Peoria. Deere & Company, a leading producer of farm machinery, is based in Moline. Factories in the Chicago area also produce construction equipment, as well as most of the state's machine tools.

Processed foods rank second in value added among the manufactured products of Illinois. Several of the nation's largest food-processing companies are headquartered in Chicago. They include Dean Foods, Quaker Oats, and Sara Lee. The Chicago area is the nation's leading food-processing center. Its chief food products include baked goods, breakfast cereals, candy, sausage, and spices. Decatur is the home of Archer Daniels Midland, a large processor of cereal grains and soybeans. The state's other food products include dairy products, sauces, and soft drinks.

Chemicals rank next in value added by manufacture. Cleaning solutions and *pharmaceuticals* (medicinal drugs) are major chemical products of Illinois. Two leading pharmaceutical companies, Abbott Laboratories and Baxter International, are headquartered near Chicago. Other chemical products made in Illinois include industrial chemicals, paint, and resins.

Fabricated metal products rank fourth among the manufactured products of Illinois. The Chicago area is the country's leading center of production for fabricated metals. These products include metal stampings, structural metal, and valves and pipe fittings.

Computer and electronic products rank fifth among the state's manufactured products. The most important kinds of electronic equipment made in Illinois are electronic components, scientific instruments, and telecommunication devices. Schaumburg is the home of Motorola, a leading producer of electronic communication equipment. Manufacturers in Franklin Park and Melrose Park make electronic components.

Printed materials are also an important manufactured product in Illinois. The Chicago area ranks second to the New York area among the nation's publishing centers. Book publishing, business printing, and newspaper publishing are important activities in the Chicago area. Large publishers based in the area include Encyclopaedia Britannica, Rand McNally, Scott Foresman-Addison Wesley, and World Book. R. R. Donnelley, the largest U.S. printing company, is based in Chicago.

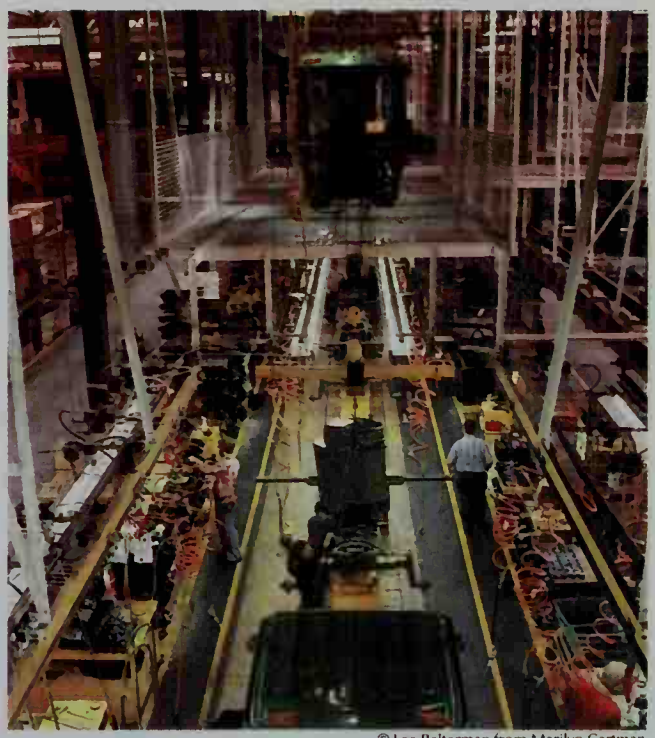
Other products made in Illinois, in order of value added by manufacture, include transportation equipment, rubber and plastics products, primary metals, and electrical products. Cars are manufactured in Belvidere, Chicago, and Normal. Plants in Freeport, Mount Vernon, and Normal make tires. Factories in suburban Chicago manufacture a wide variety of plastics products. Steel is produced in several areas of the state. Plants in Chicago and Mattoon make lighting equipment.

Agriculture. Illinois ranks among the leading states in farm income. Farmland covers about three-fourths of Illinois. There are approximately 79,000 farms in the state.

Corn has ranked as the chief crop of Illinois since pioneer days. It is grown on about 45 percent of the farmland in the state. Corn thrives throughout Illinois, but production is heaviest in the northern two-thirds of the state. Illinois grows about one-sixth of the corn crop in the United States. Farmers sell most of the corn as grain or feed it to livestock. Factories process much of the corn to make a number of corn products. These products include syrup, starch, and alcohol, which is used as a fuel.

Soybeans are the second most valuable farm product in Illinois, after corn. Illinois is one of the leading soybean-producing states. Every Illinois county produces soybeans, but production is heaviest in the east-central part of the state. Many farmers rotate corn and soybean crops in their fields from year to year.

Hay and wheat are also important crops in Illinois. Most parts of the state grow hay, which is used mainly for cattle feed. The southern third of Illinois grows the most wheat. The state's other field crops include rye, oats, and grain sorghum.



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Farm machinery is manufactured at this Moline factory. Chicago and Rock Island also are major farm-machinery producers. Illinois is a leading producer of farm machinery.

Hogs are the most valuable type of livestock product in Illinois. West-central Illinois has the greatest concentration of hog farms in the state. Hog farmers often also raise corn, which they use as feed for their hogs.

Other leading livestock products in Illinois are beef cattle and milk. The chief cattle and dairy region is the northernmost part of the state. Other livestock products in Illinois include chickens and eggs.

Cook County is one of the nation's largest producers of nursery and greenhouse products. Kankakee County is the center of large-scale production of gladioli. Other flowers grown in large quantities in Illinois for shipment to florists are carnations, chrysanthemums, and roses.

Most of the state's vegetables come from the northern half of Illinois. Illinois ranks among the leading states in the production of sweet corn for canning and freezing. Other important vegetables grown in Illinois include asparagus, cabbage, lima beans, and snap beans. Apples are the most valuable fruit crop in Illinois. Golden Delicious and Jonathan are the leading varieties of apples in the state. Other important fruits include melons and peaches. The Mississippi and Illinois river valleys are the most productive fruit-growing regions in Illinois.

Mining. Coal provides most of the mining income in Illinois, which ranks among the leading coal-producing states. Nearly all of the state's coal comes from the southern half of the state. Perry County, the leading coal-mining county, obtains all of its coal from surface mines. But most of the rest of the state's coal comes from underground mines. All of the coal in Illinois is of the bituminous variety.

Of the state's other mineral products, petroleum, crushed stone, and sand and gravel provide the largest amount of income. Most of the oil wells are in the southeastern part of the state. Limestone quarries in northeastern Illinois are the source of much of the crushed stone. Sand and gravel are produced in more than half of the state's counties. Crushed stone and sand and gravel are used mainly to make concrete and roadbeds. Other mineral products include clays and tripoli, an abrasive silica.

Electric power. Coal-burning plants supply about 55 percent of the electric power generated in Illinois. Nuclear power plants supply most of the rest of the state's power. Less than 5 percent of the power comes from hydroelectric plants and plants that burn petroleum or natural gas.

Transportation. The central location of Illinois and the state's rich resources have helped make Chicago a leading transportation center of the United States.

O'Hare International Airport, in Chicago, is one of the busiest airports in the world. Chicago's Midway Airport is the second busiest airport in Illinois.

In 1856, the Illinois Central Railroad completed a line from Cairo to Dunleith (now East Dubuque), with a branch from Centralia to Chicago. The Illinois Central line ran approximately 700 miles (1,100 kilometers), and was the world's longest single railroad at that time.

Today, about 45 railroads provide freight service in Illinois. Amtrak passenger trains serve about 35 of the state's cities and towns. Several commuter lines link Chicago with its suburban areas and with cities in northern Indiana and southeastern Wisconsin.

Illinois has about 138,000 miles (222,000 kilometers) of highways, more than any other Midwestern state. Twenty-two U.S. highways and 12 interstate routes cross Illinois. In the late 1950's and early 1960's, several expressways were built linking Chicago and its suburbs. At the same time, Chicago built the Chicago Skyway, an elevated highway that links the city with the Indiana Toll Road. The state built the Tri-State Tollway, which curves around Chicago and links Indiana with Wisconsin. The Northwest Tollway connects Chicago with Beloit and other Wisconsin cities.

Two great waterways serve Illinois—the Great Lakes and the Lakes-to-Gulf Waterway. The Great Lakes link Illinois with states to the east and the St. Lawrence Seaway. The Lakes-to-Gulf Waterway connects the Great Lakes with the Gulf of Mexico. It includes the Illinois Waterway, which links the Chicago, Des Plaines, and Illinois rivers to the Mississippi River. Chicago is one of the nation's major ports.

Communication. The first newspaper in what is now Illinois, the *Illinois Herald,* was started in Kaskaskia in 1814. Illinois has about 650 newspapers, of which about 75 are dailies. Chicago's leading newspapers are the *Sun-Times* and the *Tribune.* Other important daily newspapers in Illinois include the *Alton Telegraph, Daily Herald* of Arlington Heights, *Pantagraph* of Bloomington, *The State Journal-Register* of Springfield, *Joliet Herald-News, Peoria Journal Star,* and *Register Star* of Rockford. Illinois publishers also produce about 800 periodicals.

Illinois's oldest radio station, WDZ in Decatur, started in Tuscola in 1921. The state's first commercial television station, WBBM-TV, began broadcasting in Chicago in 1940. Today, Illinois has about 280 radio stations, 45 television stations, and 35 cable TV systems. Internet providers serve communities statewide.

Government

Constitution of Illinois was adopted in 1970 and it went into effect in 1971. The state had three earlier constitutions, adopted in 1818, 1848, and 1870. Constitutional amendments may be proposed by the state legislature. They must be approved by three-fifths of the members of each house. Then they must be approved by voters in a regular election, either by three-fifths of those voting on the proposal or by a majority of those voting in the election.

Amendments may also be proposed by a constitutional convention. A three-fifths vote in each house of the legislature is required to call a convention. The convention also must be approved by the voters in a regular election. The convention must receive approval either from three-fifths of all those who vote on the proposal or from a majority of all those who vote in the election. Amendments proposed by a convention must be approved in a special election. An amendment must get approval from a majority of the people who vote on it.

Executive. The governor and other key officials are each elected to four-year terms. Other important state officials who are elected include the lieutenant gover-

Morris Meister, Speaker's Staff, Illinois House of Representatives

The Illinois General Assembly meets in the House chambers in the State Capitol, *left,* in Springfield to hear an address by the governor. The Assembly consists of a Senate of 59 members and a House of Representatives of 118 members.

nor, attorney general, secretary of state, comptroller, and treasurer.

Legislature of Illinois is called the General Assembly. It consists of a Senate of 59 members and a House of Representatives of 118 members.

Voters in each of the state's 59 legislative districts elect one senator. Senators serve terms of either two or four years. The legislative districts are divided into three groups for senatorial elections. Each group has a different combination of terms over a 10-year period. The terms are staggered so that there will never be a complete turnover in the Senate in a single year. Each of the state's 59 legislative districts is divided into two representative districts, and voters in each of these 118 representative districts elect one member of the House of Representatives. Representatives serve two-year terms.

The Illinois General Assembly begins its legislative sessions on the second Wednesday of every January. Legislative sessions have no time limit.

Courts. The state 's court system consists of only three kinds of courts: (1) supreme, (2) appellate, and (3) circuit. Candidates for all judgeships run for office in the usual way. But judges run for reelection without opposition and serve another term if a majority of the voters approves their records.

The Supreme Court is the highest court. It has seven justices, elected to 10-year terms. Every three years, they elect one of their number chief justice. The Appellate Court has 52 judges, also elected to 10-year terms. The circuit courts are divided into 22 judicial circuits that have 865 circuit and associate judges. The circuit judges are elected to six-year terms. They appoint the associate

The governors of Illinois

	Party	Term		Party	Term
Shadrach Bond	*Dem.-Rep.	1818-1822	**John P. Altgeld**	Democratic	1893-1897
Edward Coles	*Dem.-Rep.	1822-1826	**John R. Tanner**	Republican	1897-1901
Ninian Edwards	*Dem.-Rep.	1826-1830	**Richard Yates**	Republican	1901-1905
John Reynolds	Democratic	1830-1834	**Charles S. Deneen**	Republican	1905-1913
William L. D. Ewing	Democratic	1834	**Edward F. Dunne**	Democratic	1913-1917
Joseph Duncan	Democratic	1834-1838	**Frank O. Lowden**	Republican	1917-1921
Thomas Carlin	Democratic	1838-1842	**Len Small**	Republican	1921-1929
Thomas Ford	Democratic	1842-1846	**Louis L. Emmerson**	Republican	1929-1933
Augustus C. French	Democratic	1846-1853	**Henry Horner**	Democratic	1933-1940
Joel Aldrich Matteson	Democratic	1853-1857	**John H. Stelle**	Democratic	1940-1941
William H. Bissell	Republican	1857-1860	**Dwight H. Green**	Republican	1941-1949
John Wood	Republican	1860-1861	**Adlai E. Stevenson**	Democratic	1949-1953
Richard Yates	Republican	1861-1865	**William G. Stratton**	Republican	1953-1961
Richard J. Oglesby	Republican	1865-1869	**Otto Kerner**	Democratic	1961-1968
John M. Palmer	Republican	1869-1873	**Samuel H. Shapiro**	Democratic	1968-1969
Richard J. Oglesby	Republican	1873	**Richard B. Ogilvie**	Republican	1969-1973
John L. Beveridge	Republican	1873-1877	**Daniel Walker**	Democratic	1973-1977
Shelby Moore Cullom	Republican	1877-1883	**James R. Thompson**	Republican	1977-1991
John M. Hamilton	Republican	1883-1885	**Jim Edgar**	Republican	1991-1999
Richard J. Oglesby	Republican	1885-1889	**George Ryan**	Republican	1999-
Joseph W. Fifer	Republican	1889-1893			

*Democratic-Republican

judges to four-year terms. The Circuit Court of Cook County, where Chicago is located, is the largest court in the United States. It has 404 judges.

Local government. Illinois has more than 6,300 units of local government, more than any other state. These include counties, townships, school districts, and districts formed for special purposes such as conservation or sanitation.

The state has 102 counties, most of which are divided into townships. Each county with townships, except for Cook County, is governed by a board of supervisors. These counties are divided into districts, and each district elects one supervisor to the board. Cook County is governed by a board of commissioners elected from districts. Counties without townships also are governed by an elected board of commissioners.

Illinois has more incorporated cities, towns, and villages than any other state—1,287. Most of the cities have a mayor-council form of government. Some of them have a council-manager system. The Constitution of Illinois grants *home rule* (self-government) to municipalities with populations of more than 25,000 and to counties that have an elected chief executive. Important home-rule powers include the authority to borrow money and to levy taxes. But governments with home rule may not adopt taxes on earnings, income, or occupations without the permission of the General Assembly.

Revenue. Taxation provides about 60 percent of Illinois's *general revenue* (income). Most of the rest of the state's revenue comes from federal grants and programs. Also, the Illinois lottery provides millions of dollars in revenue. The tax revenue sources include a state sales tax, license fees, and taxes on cigarettes and alcoholic beverages, individual and corporate incomes, and motor fuel.

Politics. Illinois voters are divided about evenly between the Democratic and Republican parties. Most Chicago voters are Democrats, and the majority of voters in the rest of the state are Republicans.

The Democratic organization of Chicago has great political power in the state. The city has about a fourth of the people of Illinois. As a result, the Democrats have usually controlled the state House of Representatives. Downstate Republicans have controlled the state Senate more often than the Democrats have.

The voters have elected Republicans as governor of Illinois more often than they have elected Democrats. Since the Republican Party was formed in 1856, Illinois has voted for Republican presidential candidates twice as often as Democratic candidates. For more information on the electoral votes and voting record of Illinois in presidential elections, see **Electoral College** (table).

History

Indian days. The Illinois region was once the home of prehistoric Indians who built burial and temple mounds. Several thousand of these mounds still stand in the state. The group of mounds near Cahokia includes Monk's Mound, the largest known prehistoric earthwork in the United States. See **Mound builders.**

Many of the later Indians of the region formed a union of tribes, including the Cahokia, Kaskaskia, Michigamea, Moingwena, Peoria, and Tamaroa. These tribes, called the *Illinois Confederacy,* belonged to the Algonquian family. The Iroquois Indians attacked the Illinois tribes in 1680 and killed many tribesmen. By 1800, because of warfare and exposure to European diseases, only a few Illinois Indians remained. Other tribes that played a part in the early history of the region included the Chippewa, Fox, Kickapoo, Mascouten, Miami, Ottawa, Piankashaw, Potawatomi, Sauk (or Sac), Shawnee, and Winnebago. See **Illinois Indians.**

French and British control. In 1673, Father Jacques Marquette and Louis Jolliet set out to find and trace the Mississippi River. They were sent by Louis de Buade, Comte de Frontenac, the governor general of the French colonies in what is now Canada. Marquette and Jolliet were probably the first Europeans to enter the area. They traveled south along the western boundary of what is now Illinois and later traveled north on the Illinois River. In 1675, Marquette founded a mission at the Kaskaskia Indian village near the present site of Ottawa.

In 1699, French priests founded a mission in Cahokia, a fur-trading post. This was the first permanent settlement in the Illinois region. Jesuit priests founded Kaskaskia in 1703. These two towns became the chief centers of French life in the area. For more than a hundred years, the Roman Catholic Church was the only active religious organization there. The first known Protestant preacher in Illinois was James Smith, a Baptist. Smith arrived in 1787. Joseph Lillard, a Methodist preacher, came to Illinois in 1793.

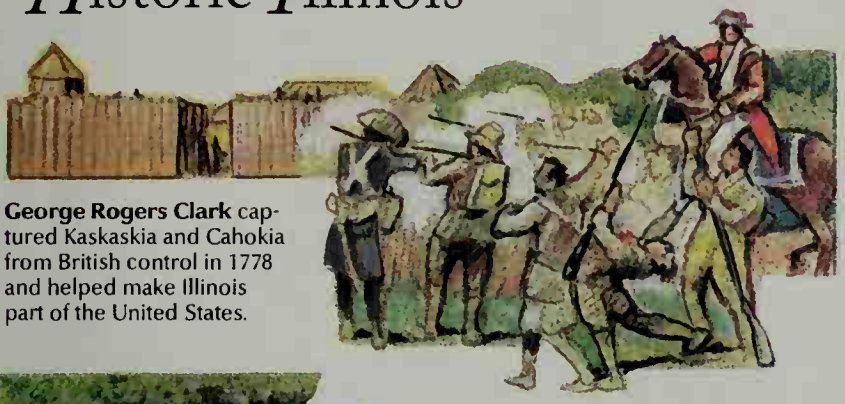
In 1717, Illinois became part of the French colony of Louisiana. That same year, John Law, a Scottish financial promoter in Paris, formed a company that brought some French colonists to Illinois (see **Mississippi Scheme**).

The French completed Fort de Chartres in 1720, northwest of Kaskaskia on the east bank of the Mississippi River. The fort was a stronghold for French villages in southwestern Illinois. In 1763, after a long war, the British won control of France's North American empire. The Indians of the Great Lakes region, who had been allies of the French, rebelled against British control. The Ottawa chief Pontiac played a major role in the rebellion but was unable to hold the tribes together against the British (see **Pontiac**). Many French settlers in Illinois were unwilling to live under British control and moved west across the Mississippi into Spanish territory.

Early national period. Fewer than 2,000 white people lived in the Illinois region before the Revolutionary War (1775-1783). They included missionaries, fur traders, French and British settlers, and British troops. George Rogers Clark of Virginia and a band of frontiersmen called the "Big Knives" captured Kaskaskia and Cahokia from British control in 1778. As a result, the region became a county of Virginia. Many soldiers who had helped Clark in this area returned as settlers after the war. Other settlers came from Kentucky, Maryland, Tennessee, and Virginia.

In 1784, Virginia gave the Illinois region to the national government. It did so because Maryland refused to ratify the Articles of Confederation unless Virginia and

Historic Illinois



George Rogers Clark captured Kaskaskia and Cahokia from British control in 1778 and helped make Illinois part of the United States.

The Lincoln-Douglas debates of 1858 were held in seven Illinois towns. Lincoln became nationally famous for his stand against slavery.

The first controlled nuclear chain reaction took place at the University of Chicago in 1942. The monument shown here marks the site of the reaction.

The Great Chicago Fire in 1871 destroyed much of the city and left about 90,000 people homeless.

WORLD BOOK illustrations by Kevin Chadwick

Important dates in Illinois

1673 Louis Jolliet of Canada and Jacques Marquette of France were probably the first Europeans in Illinois.
1699 French priests founded a settlement in Cahokia, the oldest town in Illinois.
1717 Illinois became part of the French colony of Louisiana.
1763 France included Illinois in the territory it ceded to Britain after the French and Indian War.
1778 George Rogers Clark's forces captured Cahokia and Kaskaskia during the Revolutionary War. The Illinois region became a county of Virginia.
1783 The Illinois region became part of the United States under the treaty ending the Revolutionary War.
1784 Virginia gave up its claim to Illinois to the national government.
1787 Congress made Illinois part of the Northwest Territory.
1800 Illinois became part of the Indiana Territory.
1809 Congress made Illinois a territory.
1818 Illinois became the 21st state on December 3.
1848 The completion of the Illinois and Michigan Canal provided a water connection between the Great Lakes and the Mississippi Valley.
1858 Abraham Lincoln and Stephen A. Douglas debated throughout Illinois in their senatorial campaigns.
1871 The Chicago Fire destroyed much of the city.
1886 Discontent among laborers led to the Haymarket Riot in Chicago.
1893 The World's Columbian Exposition was held in Chicago.
1900 The Chicago Sanitary and Ship Canal was completed, making the Chicago River flow backward.
1920's Illinois built a network of hard-surfaced roads.
1933-1934 The Century of Progress Exposition was held in Chicago.
1942 Scientists at the University of Chicago controlled an atomic chain reaction for the first time.
1960 One of the country's largest nuclear reactors was completed at Morris.
1965 A panel of federal and state judges reapportioned the state Senate. A special commission reapportioned the state House of Representatives.
1969 Illinois adopted individual and corporate income taxes.
1970 Illinois voters approved a new constitution, which went into effect July 1, 1971.
1986 James R. Thompson became the first Illinois governor to be elected to a fourth term.
1993 Floods caused heavy damage in Illinois.

other states that held western lands gave them up. In the Northwest Ordinance of 1787, Congress made the Illinois region part of the Northwest Territory. In 1800, Illinois became part of the Indiana Territory by an act of Congress. See **Articles of Confederation; Northwest Ordinance.**

In 1809, Congress created the Illinois Territory from what is now Illinois and Wisconsin. Kaskaskia became the capital. President James Madison appointed Ninian Edwards of Kentucky the first territorial governor.

During the early 1800's, the Indians became more and more restless because the Illinois settlers were seizing so much of their land. After Congress declared war on Britain in the War of 1812, the Indians sided with the British. The bloodiest Indian attack on the Americans took place in August 1812 when about 100 soldiers and settlers were withdrawing from Fort Dearborn, at the mouth of the Chicago River. The Potawatomi Indians killed more than half of the group. See **Fort Dearborn.**

Early statehood. Illinois became the 21st state of the Union on Dec. 3, 1818. At that time, only the southern third of the state was settled. The Northwest Ordinance had fixed the northern boundary of the future state of Illinois at a line west from the southern tip of Lake Michigan.

Nathaniel Pope, the territorial delegate to Congress, succeeded in having the northern border extended to the present northern boundary of Illinois. This change brought the Chicago area, the lead deposits around Galena, and the rich northern dairy section into the state. Otherwise, these regions would lie in the present state of Wisconsin. Almost two-thirds of the people of Illinois now live in the area added as a result of Pope's urging. In 1818, voters elected Shadrach Bond, a Democratic-Republican, as the first governor of Illinois.

In 1819, the legislature established the town of Vandalia as the future capital. The state planned to profit by selling lots there. Vandalia became the capital in 1820, with the agreement that it would remain so for 20 years.

Charles H. Kerr Publishing Company

The Haymarket Riot took place in Chicago's Haymarket Square. A bomb went off during a labor protest rally there on May 4, 1886. At least eight people died as a result.

Settlers began moving into the northern section of Illinois about 1825. That year, the Erie Canal opened across New York, and travel to the Middle West became easier. The population of Illinois grew from 55,000 in 1820 to 157,000 in 1830. The federal government moved many Illinois Indians west across the Mississippi River in the 1830's. In 1832, the Army and Illinois militiamen defeated the Sauk and Fox Indians in the Black Hawk War (see **Black Hawk**). The state then began to develop rapidly.

During the 1830's, many immigrants arrived from all parts of Europe. They farmed the land, helped build railroads, and worked in the state's factories and mines. After 1836, many Irish came to work on the Illinois and Michigan Canal, between Chicago and La Salle. Many Illinois residents were land speculators during the mid-1830's. They bought their land expecting it to become valuable as towns grew up on it.

In 1837, the question of where to locate the new capital arose in the legislature. Several cities wanted to be the capital. The delegation from Sangamon County, headed by Abraham Lincoln, succeeded in having Springfield chosen as the capital. The state offices were moved there in 1839.

In 1848, work was completed on the Illinois and Michigan Canal. This canal allowed farmers in the Mississippi and Illinois river valleys to ship grain and other products to eastern markets by way of the Great Lakes. During the 1850's, rail lines were extended to carry farm products to market. The railroads also linked such cities as Chicago, Cairo, and Quincy.

The Civil War. Illinois attracted nationwide attention in 1858 because of the debates between Abraham Lincoln and Stephen A. Douglas. The two men were campaigning for the U.S. Senate. Lincoln lost the election, but his stand on slavery led to national recognition and to his election as president of the United States in 1860. After Lincoln's election, six Southern States seceded from the Union. The Civil War (1861-1865) broke out after Lincoln's inauguration. See **Lincoln, Abraham** (The debates with Douglas).

In the early days of the Civil War, many Confederate sympathizers lived in southern Illinois. Some of them talked of establishing a separate state. But most of the people of Illinois favored the Union. President Lincoln came from Illinois, and so did Union general Ulysses S. Grant. About 260,000 Union soldiers came from Illinois.

Industrial development in Illinois made great progress after the Civil War. Railroad construction increased. The state's growing industries attracted European immigrants to the factories, forges, and mills of such cities as Chicago, Joliet, and Rockford. Chicago became the largest grain and meat-packing center in the United States. In 1871, the Chicago Fire destroyed much of the city (see **Chicago** [History]).

After 1870, huge areas of Illinois were drained and made into productive farmland. From the late 1860's to the 1890's, farmers and industrial workers throughout the country became discontented. Farmers were dissatisfied with paying high prices for equipment and shipping, while getting low prices for crops. Industrial employees had to work long hours, frequently in unhealthful and unsafe conditions. In 1886, a riot occurred at Chicago's Haymarket Square. Someone threw a bomb during a meeting organized by anarchists to protest police

Culver

A federal agent breaks barrels containing alcoholic beverages during the Prohibition Era, which lasted in the United States from 1920 to 1933. Al Capone of Chicago and gangsters in several other cities made millions of dollars from the sale of illegal beer and liquor during Prohibition.

tactics against striking workers. At least seven policemen and one civilian died as a result. The role that the anarchists played in the riot temporarily weakened support for the labor movement. See **Anarchism; Haymarket Riot.**

In 1892, farmers joined with city workers to elect Governor John P. Altgeld. His administration enforced laws on factory inspection and established a state board to help settle strikes. The state also improved the public school system and passed industrial and prison reforms.

The World's Columbian Exposition took place in Chicago in 1893. It was held during one of the nation's worst depressions of the 1800's. The depression ended by 1898, and Illinois industry then grew rapidly. By 1900, over half the people worked in cities.

In 1900, engineers completed the Chicago Sanitary and Ship Canal. This canal connected Lake Michigan with the Des Plaines River, by way of the Chicago River. The purpose of the canal was to prevent waste in the Chicago River from flowing into Lake Michigan and polluting the city's water supply. Construction of the canal caused the river to flow backward, away from the lake.

The early 1900's. Illinois was one of the most progressive states during the national reform era from the late 1890's to the early 1910's. The legislature passed several laws limiting the long working hours of women and children. In 1911, Illinois passed the country's first statewide law establishing payments from public funds to poor parents for the care of their children.

In the early 1900's, thousands of African Americans from the Deep South moved to Illinois. They were encouraged to move by the *Chicago Defender,* a black newspaper. Good rail connections contributed to the shift. Perhaps two-thirds of the blacks settled in a district of Chicago called *Bronzeville.* However, all Illinois cities had growing African American communities. Three race riots—occurring in Springfield in 1908, in East St. Louis in 1917, and in Chicago in 1919—brought national attention to Illinois. The first of these riots led directly to the founding of the National Association for the Advancement of Colored People (NAACP). See **National Association for the Advancement of Colored People (NAACP).**

After the United States entered World War I in 1917, Illinois became one of four states to furnish men for an entire Army division. This division was the 33rd, or Prairie, Division. Illinois also furnished many other servicemen. The Navy trained about 125,000 men at the Great Lakes Naval Training Center, and Fort Sheridan turned out more than 5,000 Army officers.

Prohibition and the Great Depression. Years of crime and violence in Chicago followed the federal prohibition of liquor manufacture and sales in the 1920's. Al Capone headed a $60-million-a-year illegal liquor ring. Many men died in the gang warfare between Capone's mob and rival gangs. Prohibition also led to violence in the southern part of the state, especially in Williamson County. Members of the Ku Klux Klan, a group of white secret societies, conducted raids against saloons and private homes. After the Klan lost power, the bootleggers fought among themselves for territory, much as Chicago gangsters did. See **Capone, Al; Prohibition.**

Industrial production in Illinois increased during the 1920's. Railways, waterways, and hard-surfaced roads were expanded, and cities grew rapidly. But prices of farm products dropped so low that many farmers had to give up their farms. In the 1930's, farm-mortgage acts and other federal programs helped farmers recover.

The Great Depression of the 1930's caused a sharp decrease in manufacturing, and thousands of people lost their jobs. Governor Louis L. Emmerson called a special session of the legislature in 1932 to establish funds for unemployment relief. The Century of Progress Exposition was held in Chicago in 1933 and 1934.

In 1933, the Illinois Waterway was opened. This series of canals and rivers expanded water traffic between Lake Michigan at Chicago and the Mississippi River. In 1937, the discovery of new oil fields brought an oil boom to southeast Illinois. By 1939, Illinois had climbed from 11th to 4th place among the oil-producing states.

The mid-1900's. The nuclear age began with the de-

velopment of the atomic bomb during World War II (1939-1945). A major step in that work came when Enrico Fermi and other scientists at the University of Chicago set off the first controlled nuclear chain reaction. During the war, Illinois had thousands of war plants, including more than 800 aircraft and aircraft-parts factories.

In the 1950's, the Argonne National Laboratory, near Chicago, became the leading U.S. research center in industrial uses of nuclear energy. In 1956, a nuclear reactor for industrial research was built at the Illinois Institute of Technology in Chicago. By 1960, the Chicago area had become the nation's largest steel producer.

During the 1960's, Illinois worked to attract new industries and expand existing ones. In 1960, one of the nation's largest electric-power nuclear reactors was completed at Morris. Several hundred new factories, including automobile and tire plants, went into operation. Expanded industries included the manufacture of chemicals and steel for the U.S. space program.

The battle between Democrats and Republicans for control of the state government reached an unusual climax in the 1960's. Under the Illinois constitution, the legislature must be *reapportioned* (redivided) every 10 years to provide more equal representation based on population. But in 1963, the two parties could not agree on a reapportionment plan. The main problem was the redistricting of Cook County, which included 30 of what were then the state's 59 legislative districts. Chicago, the center of Democratic power, had 23 of these districts. Republicans argued that one of their own centers of strength, Chicago's suburbs, should have two more Cook County districts. But Chicago refused to give up two districts. As a result, all districts were suspended for the 1964 elections. Representatives were elected *at large* (by voters from throughout the state).

The legislature again failed to reapportion itself in 1965. Therefore, a panel of judges reapportioned the Senate, and a special commission reapportioned the House of Representatives. The number of legislative districts in both Chicago and its suburbs was increased.

In 1964, a constitutional amendment streamlining the Illinois court system went into effect. The system now consists of three kinds of courts—supreme, appellate, and circuit. The state abolished all lower courts and expanded the duties of the circuit courts.

In 1968, work began on the Fermi National Accelerator Laboratory near Batavia. The laboratory went into operation in 1972, and scientists and engineers from throughout the world conduct high-energy physics research there. The laboratory is one of the world's leading centers for study of the atom.

In 1969, the Illinois legislature approved individual and corporate state income taxes for the first time. In 1970, Illinois voters approved a new state constitution. The new constitution went into effect in 1971, replacing the constitution that had been adopted in 1870.

The late 1900's. Illinois's industrial and population growth during the 1960's brought problems as well as benefits. The industrial expansion led to increased air and water pollution. In 1970, voters approved a $750-million bond issue to improve sewage disposal and to fight water pollution. The population growth created a need for more public services and led to higher taxes. In 1973, the legislature adopted a lottery to help raise revenue for education and other services.

Illinois continued to thrive industrially, with Chicago the center of activity. During the 1980's and 1990's, Illinois experienced substantial growth in high-technology industries in the area around Cook County that includes Lake, DuPage, and Will counties. In 1988, an automobile manufacturing plant opened in Normal. The state continued efforts to attract still more industry and to increase foreign markets for Illinois products.

Recent developments. In early 2000, Governor George Ryan declared a *moratorium* (temporary halt) on the death penalty in Illinois and called for a review of the capital punishment system. He said he wanted to make sure that innocent people were not being put to death. Illinois had reinstated capital punishment in 1977. Since that time, 13 people who were sentenced to die were found to have been wrongfully convicted.

In 2002, a 14-member commission Ryan had appointed to examine the state's capital punishment system released its report. The commission called for a sweeping overhaul of the system. Ryan submitted to Illinois lawmakers proposed legislation based on the commission's report. He said the moratorium on capital punishment would remain in effect while the state legislature considered the proposed reforms.

Theodore J. Karamanski and William D. Walters, Jr.

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Questions

What is the state's most important natural resource?
Whose 1858 debates in Illinois attracted nationwide attention?
Which region has the state's tallest hills and deepest valleys?
What has made the Chicago area a center of nuclear research?
Why does the climate of Illinois vary greatly?
What river in Illinois flows backward? Why?
When did the first known Illinois school open?
What is the state's chief crop?
Where was the first permanent settlement in the Illinois region?

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Illinois, University of, is a state-supported, coeducational institution with three campuses. One campus is in Urbana-Champaign, the second is in Chicago, and the third is in Springfield.

The Urbana-Champaign campus has colleges of agricultural, consumer, and environmental sciences; applied life studies; commerce and business administration; communications; education; engineering; fine and applied arts; law; liberal arts and sciences; and veterinary medicine. It also includes schools of library and information science; architecture; art and design; chemical sciences; human resources and family studies; life sciences; music; social work; and social sciences.

The National Center for Supercomputing Applications, the Educational Resources Information Center (ERIC) Clearinghouse on Early Childhood Education, and other national research centers are at Urbana-Champaign. Other programs include a graduate college and a number of specialized institutes. The library ranks among the largest university libraries.

The Chicago campus has colleges of architecture and the arts; business administration; education; engineering; liberal arts and sciences; social work; and urban planning and public affairs. An honors college and a graduate college are also available.

The University of Illinois at Chicago (UIC) Medical Center is on the Chicago campus. Health-related programs include the colleges of associated health professions, dentistry, medicine, nursing, and pharmacy, and the school of public health.

The Chicago campus includes a major sports and entertainment center called the UIC Pavilion and other facilities important to the community. Hull House, a national historic landmark, is also there.

The Springfield campus has schools of business and management; health and human services; liberal arts and sciences; and public affairs and administration. These schools offer courses for undergraduates, beginning at the second-semester sophomore level, and for graduate students.

The Institute for Public Affairs provides a special focus on government and community service for this campus. The institute directs educational, research, and service programs devoted to solving public problems at state and local levels. The institute shares information with the community through public radio and television stations, a monthly magazine, and the World Wide Web.

History. The university was chartered in 1867 and opened in Urbana-Champaign in 1868. The first *betatron,* a machine that accelerated electrons for nuclear physics experiments, was built there in 1940.

The university opened a medical center in Chicago in 1881. The University of Illinois at Chicago was created 101 years later, in 1982, by combining the medical center with the undergraduate and graduate programs at the Chicago Circle campus. In 1995, the Illinois state legislature designated the former Sangamon State University in Springfield as a third campus for the University of Illinois.

Critically reviewed by the University of Illinois

See also **Hull House.**

Illinois Indians, *IHL uh NOY,* were expert archers and continued to use bows and arrows long after most tribes had adopted guns. They were also called the Illini Indians.

The Illinois formed a confederacy of woodland tribes, closely related to the Miami. Individual groups in the Illinois confederacy included the Cahokia, Kaskaskia, Michigamea, Moingwena, Peoria, and Tamaroa. Illinois Indians called themselves *Illini* or *Iliniwek,* meaning *the men.* The French called them the Illinois.

Illinois Indian tribes lived in what is now Illinois, southern Wisconsin, and parts of Iowa and Missouri. Several families lived together in bark-covered cabins that had arched roofs. They raised corn, and buffalo supplied the families with much of their food and clothing. Both the men and the women tattooed their bodies. Warriors of the Illinois tribes shaved their heads, except for a scalp lock and other hair in front of, and behind, each ear.

The Illinois controlled the so-called Illinois Country until about 1660, when the Iroquois began to move westward and attack them. During the next 100 years, the Illinois struggled to keep their lands. Eventually, the Illinois retreated southward and westward. Sauk, Fox, Sioux, and other tribes killed many Illinois. When an Illinois Indian killed Pontiac, the Ottawa Indian chief, in 1769, northern Indians increased their raids. Most of the remaining Illinois Indians then settled in Oklahoma.

R. David Edmunds

Illinois River, *IHL uh NOY,* is the largest and most important water route in Illinois. The river is part of the waterway system that links the Great Lakes with the Gulf of Mexico.

The Illinois River starts at the meeting of the Kankakee and Des Plaines rivers about 45 miles (72 kilometers) southwest of Chicago (see **Illinois** [physical map]). It flows southwest for 273 miles (439 kilometers) and empties into the Mississippi River about 50 miles (80 kilometers) north of St. Louis. The Illinois River drains about 25,000 square miles (64,700 square kilometers) of land. It forms the southern part of the Illinois Waterway, which links Lake Michigan with the Mississippi River.

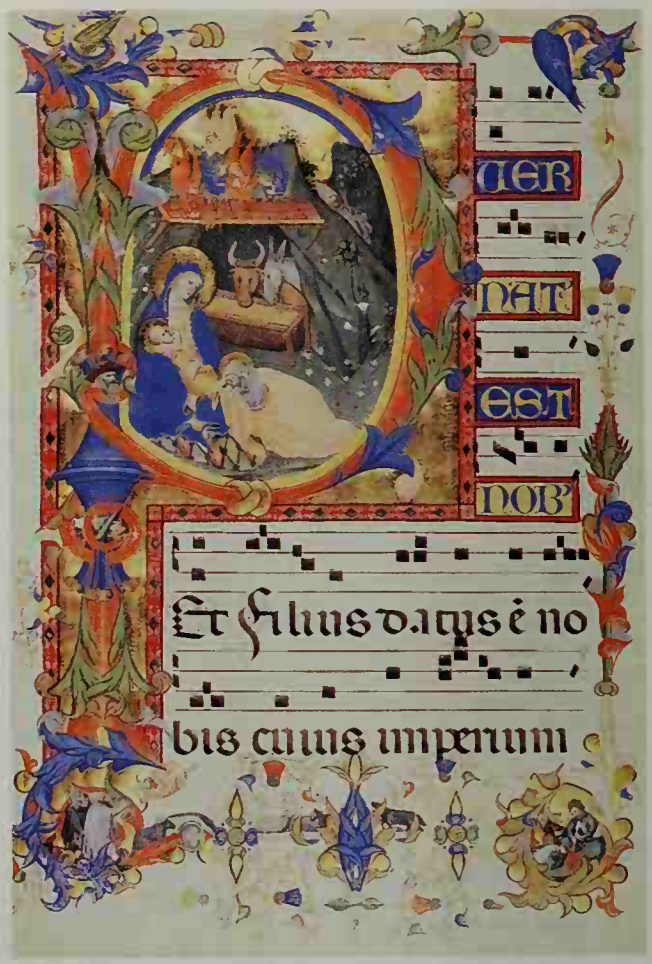
William D. Walters, Jr.

Illiteracy. See Literacy; Reading.

Illuminated manuscript is a book written and decorated by hand. *Illumination* refers to the art of decorating books with bright colors and precious metals so they seem to glow.

Illuminated manuscripts flourished during the Middle Ages and the Renaissance. Many kinds of books were illuminated. They included works in Latin and in *vernacular* (native) languages. The most common illuminated manuscripts were Bibles, prayer books called Books of Hours, choir books, collections of Psalms called Psalters, learned treatises, chronicles, romances, and poetry.

A page could receive a variety of illuminations, either tied to the text or independent of it. A *historiated initial* introduced the text with a scene or figure within an enlarged letter. A *decorated initial* introduced the text with a letter adorned with various *motifs* (designs). *Line endings* filled out a line of text with decoration to the margin. *Drolleries* were amusing human or animal figures often painted in a page's borders. *Border decoration* consisted of pictures and designs surrounding the text in its margins. An independent painting in a manuscript is called a *miniature.*



Illumination (late 1300's) by Silvestro dei Gherarducci; Pierpont Morgan Library, New York City (Art Resource)

An illumination called a *historiated initial* from a choir book shows a Nativity scene within the letter P. Pictures and designs called *border decoration* surround the text.

Manuscript illuminators worked with natural animal, mineral, and vegetable substances in their paint. They especially prized a brilliant shade of blue made with the gem lapis lazuli. In addition, illuminators used the precious metals gold and silver. For practical reasons, the illumination was nearly always added after the text was written.

Beginning in the 500's, illuminated manuscripts were made primarily by monks working in the *scriptoriums* (writing rooms) of monasteries. As early as the 1200's, illumination shifted to craftworkers who lived and worked in cities. Even after the invention of printing during the mid-1400's, the illuminated manuscript persisted as a specialized form of book. Sandra L. Hindman

See also **Limbourg, Pol de; Painting** (Medieval painting); **Manuscript; Byzantine art.**

Illusion. See **Optical illusion; Perception** (Learning, emotion, and motivation); **Color** (Surprising color-vision effects); **Magician** (Illusions).

Ilmen, Lake. See **Lake Ilmen.**

Ilmenite, *IHL muh nyt* (chemical formula, $FeTiO_3$), is a black, heavy mineral, important as a source of titanium (see **Titanium**). It is formed at high temperatures and contains 36.8 percent iron and 31.6 percent titanium. Dif-

ficulties in smelting ilmenite prevent its widespread use as iron ore. In the United States, ilmenite is mined in Florida and North Carolina. Robert B. Cook

ILO. See **International Labour Organization.**

Iloilo, *EE loh EE loh* (pop. 365,820), is one of the chief ports of the Philippines. The city lies on the southeastern coast of Panay Island, in the Visayan Islands of the Philippines (see **Philippines** [map]). The Iloilo River flows through the city and forms an excellent harbor. The city is the chief shipping port for nearby Negros Island, a sugar-producing center. Iloilo is a cultural center of the Visayan Islands. David J. Steinberg

Image orthicon, *AWR thuh kahn,* is a vacuum tube used in some television cameras to take the television picture. It changes light from the scene being televised into electronic signals. The image orthicon was developed by the RCA Corporation in the early 1940's. Until the mid-1960's, most television cameras used the image orthicon. Most cameras that have been built since then use *vidicon* tubes. See **Television** (The television camera).

The front of the image orthicon contains a screen called a *photocathode* that releases electrons when light from the camera lens strikes it. Bright parts of the scene knock out more electrons than dim parts do. Another screen behind the photocathode, called the *target,* attracts the released electrons, and a positively charged electronic image of the scene forms on the target. This image consists of highly and weakly charged spots that correspond to the bright and dim areas of the scene. A beam of electrons then scans the target, which absorbs electrons from the beam in proportion to those knocked out by the image. The remaining electrons in the beam bounce from the target.

At the rear of the image orthicon, a device called an *electron multiplier* strengthens the returning beam several thousand times. This beam becomes the television picture signal. Thomas T. Liao

See also **Iconoscope.**

Imaginary number. See **Square root** (Square roots of negative numbers).

Imagination is the capacity to consider objects or events in their absence or as they might be. Imagination may refer to many things, such as fantasy, ingenuity, daydreaming, and make-believe. But it often involves the use of *mental imagery,* which is the ability to call to mind the sensations of sights, sounds, tastes, smells, and touches that have been experienced.

Through mental imagery, people can also create mental sensations of situations or conditions they have not actually experienced. Imagination plays an important role in creativity, including the formation of abstract ideas. Mental images can substitute for the real thing, allowing a person to plan how to paint a picture, compose a song, and so on.

Mental imagery is produced by the same parts of the brain used in actual perception. This fact sometimes leads people to mistake objects in their mental images for real objects. Brain damage can also disrupt mental imagery and perception in the same ways.

People differ widely in their abilities and tendencies to use different aspects of imagery. For example, some people are better than others at moving objects in images. They can visualize an *N* changing into a *Z* when rotated to a certain point. In addition, some people are better than others at picturing more objects in their images or at creating new objects in images.

Imagination plays an important role in a child's life. Children tend to use imagery in thinking more than adults do. But children have more difficulty than adults in using imagery effectively. This difficulty contributes to the problems that children experience in reasoning about objects and ideas. S. M. Kosslyn

See also **Dream; Hallucination; Memory; Theater** (The performers).

Imagists. See **Poetry** (Poetry of the 1900's).

Imago, *ih MAY goh,* is the fully developed insect which emerges from the pupa at the end of the third stage of metamorphosis in an insect life. See **Metamorphosis.**

Imhotep, *ihm HOH tehp,* was an ancient Egyptian architect, physician, and statesman who lived about 2650 B.C. Imhotep was one of the highest ranking officials in Egypt. He designed and built the first known Egyptian pyramid, for King Zoser. The pyramid, which stands in the village of Saqqarah, near present-day Cairo, was also one of the first large stone structures to be built. Imhotep had a reputation for wisdom that probably came from a text he wrote called *Instruction.*

There are no existing records of Imhotep's medical work. Scholars know of his fame as a physician because the Greeks identified him with their god of healing, Asclepius (see **Asclepius**). They built shrines and made hundreds of bronze statuettes in Imhotep's honor.

Today, the field of medicine honors him as the first physician known by name. A statue of Imhotep stands in the Hall of Immortals in the International College of Surgeons in Chicago. Leonard H. Lesko

Immaculate Conception, *ih MAK yuh liht kuhn SEHP shuhn,* is a doctrine of the Roman Catholic Church. It means that the Virgin Mary, in order to be pure enough to become the mother of Jesus Christ, was conceived free from original sin. Her soul was created in the purest holiness and innocence. The doctrine of the Immaculate Conception was formally defined by Pope Pius IX on Dec. 8, 1854.

The term is often confused among non-Catholics with the *Virgin Birth.* But the Virgin Birth has no connection with the Immaculate Conception. Mary had two human parents. The Virgin Birth is the belief, recorded in Matthew 1:18-25 and Luke 1:26-38, that Jesus Christ was conceived by the Holy Spirit and born of the Virgin Mary. She had asked the angel Gabriel how she, a virgin, could become the mother of the promised Messiah. She was told this would be by the power of God (Luke 1:34-38). J. H. Charlesworth

See also **Murillo, Bartolomé E.** (picture).

Immersion foot, *ih MUR zhuhn,* also known as *trench foot,* is a diseased condition of the lower limbs and feet that is caused by prolonged exposure to wet cold. The symptoms of immersion foot resemble those of mild to moderate frostbite. Soldiers, outdoor workers, and hunters often suffer immersion foot. The condition is treated like frostbite—by cleanliness, rest, measures to restore circulation to affected areas of the body, and treatment of any underlying infection. Deep tissue damage is unusual. Carlotta M. Rinke

See also **Frostbite.**

Culver

Millions of European immigrants streamed into the United States during the 1800's and early 1900's. The newcomers shown here landed at Ellis Island in New York Harbor. Ellis Island was the chief U.S. reception center for immigrants from 1892 to 1924.

Immigration

Immigration is the act of coming to a foreign country to live. The act of leaving one's country to settle in another is called *emigration*. Immigrants who flee their country because of persecution, war, or such disasters as famines or epidemics are known as *refugees* or *displaced persons* (DP's).

Most people find it very hard to pull up roots in their native land and move to a strange country. But throughout history, countless millions of people have done so. The heaviest immigration worldwide took place from the early 1800's to the Great Depression—the economic hard times of the 1930's. In that period, about 60 million people moved to a new land. Most came from Europe. More than half immigrated to the United States. Other destinations included Argentina, Australia, Brazil, Canada, New Zealand, and South Africa.

Today, the availability of fast, safe, and cheap transportation helps make migration easier. Asia is replacing Europe as the major immigrant-sending area. The United States remains the chief receiving nation.

Causes of immigration

People forsake their homeland and move to another country for various reasons. Some emigrate to avoid starvation. Some seek adventure. Others wish to escape unbearable family situations. Still others desire to be reunited with loved ones.

Religious persecution has led many people to move to a new land for the freedom to practice their faith. Such emigrants include Jews expelled from England in the 1200's and Bahá'ís fleeing Iran in the 1980's.

Wars, revolutions, and political unrest have driven innumerable people to find new homes. In the 1990's alone, millions of refugees fled from warfare in Bosnia-Herzegovina, East Timor, Ethiopia, Iraq, Liberia, Rwanda, and the Serbian province of Kosovo.

Some immigrants were brought to a new land against their will. From the 1500's to the 1800's, Europeans shipped black Africans to the Western Hemisphere as slaves. The United Kingdom transported convicts to Australia from the late 1700's to the 1860's to relieve overcrowding in British jails. Before that time, the United Kingdom sent convicts to the American Colonies.

The main reason for immigration, however, has long been economic opportunity—the lure of better land, a better job, or a better life. During the 1800's, for example, the rich prairie land of the United States and Canada attracted many European farmers. Many more European immigrants sought work in the growing U.S. industries. Today, professional people commonly emigrate because of better opportunities elsewhere. For example, many Philippine doctors and nurses and numerous Indian doctors, engineers, and scientists have moved to the United States and Canada.

Effects of immigration

Not all immigrants remain in their adopted land. Some go intending to stay for a short time and then return home. Some go to a new country for a specific reason, such as school, a job, or marriage. Then, when they graduate or if they lose their job, retire, or become divorced or widowed, they may decide to return home. But others go back because they find adjusting to a new society too difficult.

Many immigrants to a new country first settle in a community made up of people from their native land or even their native village. They keep their old customs and acquire a limited knowledge of their new country's culture, language, and values. In time, however, most immigrants, and especially their children, begin to *assimilate* (adapt to a new culture). Immigrants who adapt most quickly usually have a background similar to the new cultural environment and much contact with the

UPI/Bettmann Archive

Cambodian refugees fled to Thailand in 1979 after Vietnamese troops invaded their homeland. Wars have driven countless people to find a new home.

new society. They also plan to remain permanently.

Most immigrants find a job and strive to buy a home. They try to provide their children with the education and opportunities not available in the immigrants' native land. They become citizens of the new country and take part in politics and government.

Immigrants have made enormous contributions to the culture and economy of such nations as Argentina, Australia, Brazil, Canada, Israel, New Zealand, and the United States. But their accomplishments have been made with great difficulty. Many of the receiving countries have restricted immigration to maintain a *homogeneous society* in which all the people shared the same ethnic, geographic, and cultural background. Although some immigration laws have been relaxed, many newcomers of different backgrounds still face challenges in gaining acceptance.

Population movements have mixed effects on the sending and receiving nations. Emigration relieves overcrowding in a country; yet the country may lose many people with valuable skills. The receiving nation gains new workers but may have trouble providing the immigrants with jobs, education, social services, and even housing.

The effects of population movements on the world economy are difficult to measure because nations have become increasingly dependent on one another. For example, many emigrants take their skills with them, while others acquire skills in the new country, accumulate savings, and then return home. Some immigrants establish businesses with trade links to their homeland. Many immigrants stay permanently in their new country but regularly send money to families left behind. Some immigrants return to their native land after they retire.

Immigration to the United States

The United States has long been the world's chief receiving nation for immigrants and refugees. The country has had four major periods of immigration. The first wave began in what is now the United States with the colonists of the 1600's and reached a peak just before the Revolutionary War in America broke out in 1775. The second major flow of immigrants started in the 1820's and lasted until a depression in the early 1870's. The greatest inpouring of people took place from the 1880's to the early 1920's. A fourth and continuing wave began in 1965 because of changes in U.S. immigration laws.

The first wave. Most of the immigrants who settled in the American Colonies in the 1600's came from England. Others arrived from France, Germany, Ireland, Wales, the Netherlands, and Scotland. Several thousand Spanish colonists settled in what is today the southwestern United States.

Some colonists sought adventure. Others fled religious persecution. Many were convicts transported from English jails. But most immigrants by far hoped for economic opportunity. Many could not afford the pas-

Major immigration movements to the United States

Who	When	Number	Why
Irish	1840's and 1850's	About 1 $\frac{1}{2}$ million	Famine resulting from potato crop failure
Germans	1840's to 1880's	About 4 million	Severe economic depression and unemployment; political unrest and failure of liberal revolutionary movement
Danes, Norwegians, and Swedes	1870's to 1900's	About 1 $\frac{1}{2}$ million	Poverty; shortage of farmland
Poles	1880's to 1920's	About 1 million	Poverty; political repression; cholera epidemics
Jews from Eastern Europe	1880's to 1920's	About 2 $\frac{1}{2}$ million	Religious persecution
Austrians, Czechs, Hungarians, and Slovaks	1880's to 1920's	About 4 million	Poverty; overpopulation
Italians	1880's to 1920's	About 4 $\frac{1}{2}$ million	Poverty; overpopulation
Mexicans	1910 to 1920's 1950's to 1990's	About 700,000 About 5 million	Mexican Revolution of 1910; low wages and unemployment Poverty; unemployment
Cubans	1960's to 1980's	About 700,000	Communist take-over in 1959
Dominicans, Haitians, and Jamaicans	1970's and 1980's	About 900,000	Poverty; unemployment
Vietnamese	1970's and 1980's	About 500,000	Vietnam War (1957-1975); Communist take-over

Source: U.S. Immigration and Naturalization Service.

sage to the Colonies and came as *indentured servants.* Such a servant signed an *indenture* (contract) to work for a master for four to seven years to repay the cost of the ticket. Blacks from West Africa came to the colonies involuntarily. Some of the first Africans were brought as indentured servants, but most blacks arrived as slaves. West African blacks captured most of the slaves in wars and traded them for European goods.

By 1700, there were about 250,000 people living in the American Colonies. Approximately 450,000 immigrants arrived between 1700 and the start of the Revolutionary War. During that period, fewer English immigrants came, while the number from Germany, Northern Ireland, and Scotland rose sharply. Most immigrants arrived in Philadelphia, the main port in the colonies.

Wars in Europe and the United States slowed immigration during the late 1700's and early 1800's. Newcomers included Irish fleeing English rule and French escaping revolution. Congress made it illegal to bring in slaves as of 1808. By that time, about 375,000 black Africans had been imported as slaves.

During the early 1800's, New York City began to replace Philadelphia as the nation's chief port of entry for immigrants. The country's first immigration station, Castle Garden, opened in New York City in 1855. Ellis Island, the most famous station, operated in New York Harbor from 1892 to 1954.

The second wave. From 1820 to 1870, almost 7 $\frac{1}{2}$ million newcomers entered the United States. Nearly all of them came from northern and western Europe. About a third were Irish, many of them seeking escape from a famine that struck Ireland in the mid-1840's. Almost a third were German. Most of the Irish had little money, and so they stayed where they arrived, on the East Coast. Many Germans had enough money to journey to the Midwest in search of farmland.

In the mid-1800's, some states sent agents to Europe to attract settlers. Railroad companies did the same thing. Better conditions on ships and steep declines in travel time and fares made the voyage across the Atlantic Ocean easier and more affordable. In the mid-1800's, news of the discovery of gold in California reached China. Chinese immigrants and *sojourners* streamed across the Pacific Ocean to strike it rich. Sojourners were temporary immigrants who intended to make money and return home. French-Canadian immigrants and sojourners opened still another path to the United States. They moved across the Canadian-U.S. border into the New England States and Michigan.

Granger Collection

German immigrants, shown in this painting boarding a train from Chicago to Colorado, were the largest group of newcomers from 1860 to 1892.

The flood of immigrants began to alarm many native U.S. citizens. Some feared job competition from foreigners. Others disliked the politics of the newcomers, or the fact that many immigrants were Roman Catholics. During the 1850's, the American Party, also called the Know-Nothing Party, demanded laws to make it harder for foreigners to become citizens. Although the party soon died out, it reflected the serious concerns of some Americans.

During the 1870's, the U.S. economy suffered a depression while the economies of Germany and the United Kingdom improved. German and British immigration to the United States then decreased. But arrivals increased from Canada, China, Denmark, Norway, Sweden, and southern and eastern Europe. In 1875, the United States passed its first restrictive immigration law. It prevented convicts and prostitutes from entering the country. During the late 1870's, Californians demanded laws to keep out Chinese immigrants. In some instances, mobs attacked Chinese immigrants, who were accused of lowering wages and of unfair business competition. In 1882, Congress passed the Chinese Exclusion Act, which prohibited Chinese laborers from coming to the United States.

The third wave. From 1881 to 1920, almost 23 $\frac{1}{2}$ million immigrants poured into the United States from almost every part of the world. Until the 1880's, most newcomers still came from northern and western Europe. They came to be called *old immigrants.* Beginning in the 1890's, the majority of arrivals were *new immigrants,* people from southern and eastern Europe.

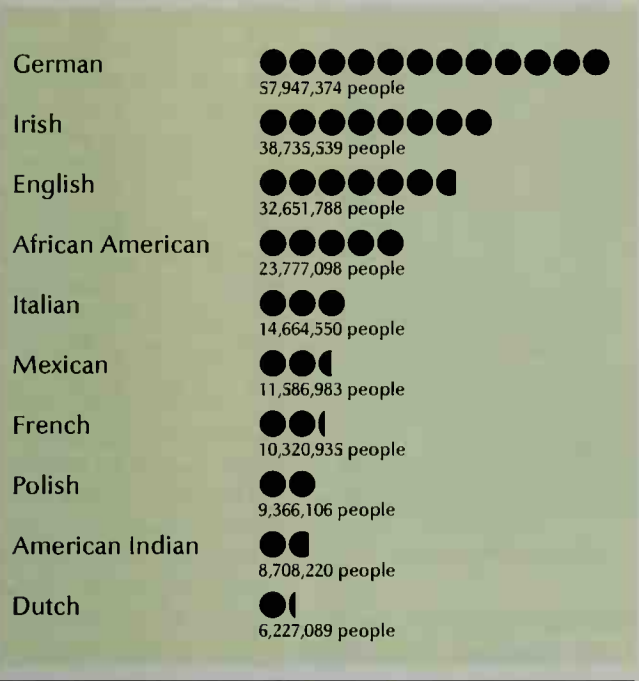
More and more native U.S. citizens believed the swelling flood of immigrants threatened the nation's unity. Hostility like that which had boiled over against the Chinese in the 1870's now turned against Jewish people, Catholics, Japanese, and the new immigrants in general.

In 1882, Congress expanded its list of unacceptable immigrants to include such people as beggars, contract laborers, the mentally ill, and unaccompanied children. A 1917 law required adult immigrants to show that they could read and write. The law also excluded immigrants from an area known as the Asiatic Barred Zone, which covered most of Asia and most islands in the Pacific.

In 1921, Congress limited the number of people entering the country. New laws severely reduced immigration and limited the number of immigrants from any one country. The Immigration Act of 1924, which took effect in 1929, limited the number of immigrants from outside the Western Hemisphere to about 153,700 a year. The distribution of immigrants from different countries was based on percentages of the nationalities making up the white population of the United States in 1920. The formula ensured that most immigrants would be from such countries as Germany, Ireland, and the United Kingdom.

A temporary decline—1930-1945. During the Great Depression, U.S. immigration dropped sharply. Only about 500,000 immigrants came from 1931 to 1940—and in some years more people left than arrived. World War II (1939-1945) led to an easing of immigration laws. The

10 largest ancestry groups in the United States



Figures are from the 1990 census and include some people who named more than one ancestry group. Source: U.S. Bureau of the Census.

War Brides Act of 1945 admitted the spouses and children of U.S. military personnel who had married while abroad. China became an ally during the war, and so the ban against Chinese immigrants was lifted. In 1952, the Immigration and Nationality Act, also called the McCarran-Walter Act, established *quotas* (allowable numbers) for Asian countries and other areas from which immigrants had been excluded. The law, for the first time, made citizenship available to people of all origins.

Congress began to set separate provisions for refugees. The Displaced Persons Act of 1948 and the Refugee Relief Act of 1953 opened the country to about 600,000 Europeans and Soviet citizens left homeless by World War II. During the 1950's and 1960's, the United States received thousands of refugees from revolutions in China, Hungary, and Cuba.

The fourth wave. In 1965, amendments to the Immigration and Nationality Act ended quotas based on nationality. Instead, the amendments provided for annual quotas with a ceiling of 170,000 immigrants from the Eastern Hemisphere and 120,000 from the Western Hemisphere. The act established a preference system for the issuing of *visas* (permits) that strongly favored relatives of U.S. citizens and permanent resident aliens, as well as people with special skills. Wives, husbands, parents, and minor children of U.S. citizens could enter without being counted as part of the quota. In 1978, Congress replaced the separate quotas for immigrants from the Eastern and Western hemispheres with a single annual world quota of 290,000.

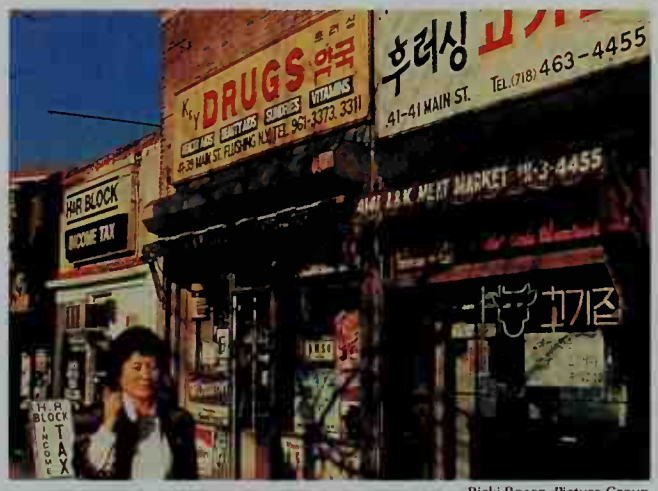
The 1965 amendments produced major changes in patterns of immigration to the United States. The percentage of immigrants from Europe and Canada dropped, while that of immigrants from Asia and the West Indies leaped dramatically. Today, the largest groups of United States immigrants come from Mexico, the Philippines, Vietnam, the Dominican Republic, China, India, Cuba, Ukraine, Jamaica, and South Korea. The immigrants from South Korea include many people who were born in North Korea. A large number of newcomers still settle in the East and Midwest. However, many other immigrants move to Florida and California.

Under the 1965 amendments, refugees could make up 6 percent of the Eastern Hemisphere's annual quota for immigration to the United States. This rule was later extended to the Western Hemisphere. But the percentage was too small for the flow of refugees from war-torn Southeast Asia in the 1970's or the streams of people from Haiti and Cuba. To address these issues, Congress passed the Refugee Act in 1980. This law provided for the settling of 50,000 refugees each year. However, the president could admit additional refugees if there were compelling reasons to do so. As a result, about 100,000 refugees entered the United States annually in the 1990's.

In 1924, the United States established the Border Patrol to prevent unlawful entry along U.S. boundaries. But the problem of illegal immigration has grown steadily. Experts estimate that millions of *illegal aliens* live in the United States. Illegal aliens, also called *undocumented aliens,* are noncitizens living in a country without proper visas or other documents. A majority of undocumented aliens in the United States are from Mexico.

The Immigration Reform and Control Act of 1986 offered *amnesty* (pardon) to illegal aliens who had lived in the United States continuously since before Jan. 1, 1982, or who had worked at least 90 days at farm labor in the United States between May 1, 1985, and May 1, 1986. The act also set penalties on employers who knowingly hire illegal immigrants. By the end of the amnesty period in 1988, about 3 million illegal aliens had applied for amnesty. However, hundreds of thousands of others did not apply for various reasons, including the cost and confusion involved in filing, concerns about splitting up families, and the lack of residency or employment records. Critics of the law claimed that it did not significantly reduce the flow of illegal aliens into the country.

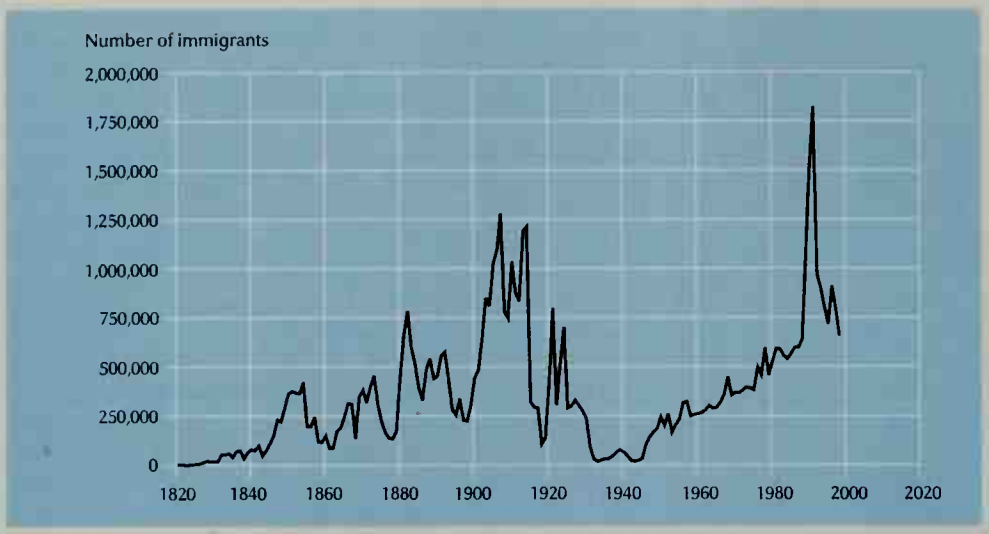
In 1990, further amendments to the Immigration and Nationality Act of 1952 increased the number of immigrants allowed into the United States each year. Ceilings were fixed at 700,000 annually for 1992 to 1994 and



Ricki Rosen, Picture Group

Asians have become a major immigrant group in the United States since 1965. The street shown here is in a Korean neighborhood in the Flushing section of Queens in New York City.

Number of legal immigrants admitted to the United States annually since 1820



Year	Number of immigrants
1820	8,400
1830	23,300
1840	84,100
1850	370,000
1860	153,600
1870	387,200
1880	457,300
1890	455,300
1900	448,600
1910	1,041,600
1920	430,000
1930	241,700
1940	70,800
1950	249,200
1960	265,400
1970	373,300
1980	530,600
1990	1,536,500
1995	720,500
1998	660,477

Figures from 1989 through 1992 include people granted permanent residence through the Immigration Reform and Control Act of 1986.
Source: U.S. Immigration and Naturalization Service.

675,000 annually beginning in 1995. Like the 1965 amendments, the 1990 amendments placed no limit on the number of U.S. citizens' immediate relatives who could enter the country each year. The ceilings also did not include refugees. The 1990 amendments gave additional preference to people from countries that had sent relatively few immigrants to the United States after 1965, including many European and African nations.

People who seek legal admission to the United States apply at the U.S. consulate in their home country for a visa. They must prove, among other things, that they do not have an infectious disease or a criminal record. Immigration laws favor relatives of U.S. citizens, refugees, and people with skills needed in the United States. Others may have to wait years, particularly in countries that have many people wishing to emigrate.

Immigration to other countries

The most commonly traveled immigration route has long led from Europe to the United States. But other countries have also received many immigrants. This section discusses immigration to other parts of the world.

Canada. The French and later the British colonized Canada. From 1850 to 1930, about 6 $\frac{1}{2}$ million people immigrated to Canada. About half came from the United Kingdom and the United States. During the late 1800's, Chinese immigrants were brought in to help construct the Canadian Pacific Railway. To discourage Chinese immigration after completion of the railway in 1885, Canada placed increasingly heavy entry taxes on newly arrived Chinese. In 1923, Canada barred the entry of Chinese immigrants. Today, immigrants are admitted regardless of their ancestry, race, religion, or sex. In the mid-1990's, Canada received about 200,000 immigrants a year. More than half were Asians, including the Chinese who had been barred before. Canada also received refugees from the Vietnam War (1957-1975). Canada accepts fewer immigrants than the United States does, but a larger percentage of its population is foreign-born.

Latin America. Most Latin American countries gained independence from their European rulers in the early 1800's. At that time, only Argentina, Brazil, and a few other countries sought immigrants. From 1850 to 1930, more than 11 million immigrants arrived in Latin America. About 5 $\frac{1}{2}$ million of them—mainly Italians and Spaniards—went to Argentina. About 4 million—mainly Italians and Portuguese—went to Brazil. Many of the newcomers did not stay in those countries, however.

During the 1950's, Venezuela joined Argentina and Brazil as a major immigrant-receiving country. After the 1950's, immigration to Latin America declined because of the region's lack of jobs and its rapidly growing population. In addition, Argentina and Brazil limited Asian immigration. However, much immigration took place within Latin America. Many Latin Americans fled to Ar-

Chief sources of current immigration to the United States by country of birth

*Figures for North Korea and South Korea are not reported separately.
Figures are for 1998. Source: U.S. Immigration and Naturalization Service.

gentina and Venezuela to escape political unrest. During the 1980's, immigrants were unskilled workers moving among the countries of Latin America. Many professionals immigrated to countries outside the region.

Australia and New Zealand were colonized by the United Kingdom beginning in the late 1700's. After gold was discovered in Australia in 1851 and in New Zealand in 1861, non-British immigrants began to arrive. By the 1880's, the immigrants included more than 40,000 Chinese in Australia and over 4,000 in New Zealand. The two countries then limited Chinese immigration. In the early 1900's, they established policies designed to preserve a "white Australia" and a "white New Zealand." They tried to attract British and other favored immigrants by offering free transportation.

After World War II ended in 1945, Australia started to welcome European refugees. In 1975, the country began admitting Southeast Asian refugees and Chinese immigrants seeking a better life. New Zealand eased its immigration restrictions in 1986. But both countries still strongly prefer immigrants of European origin and give limited welcome to others.

Asia. Except for Israel, most immigrants to Asia came from other Asian countries. By the 1920's, more than 8 million Chinese lived outside China, chiefly in the Philippines, in what is now Indonesia, and in other Southeast Asian lands. The Communist take-over of China in 1949 led 2 million more Chinese to emigrate.

By the 1920's, about 750,000 Japanese had moved to China, Korea, and other countries of eastern Asia. Also by the 1920's, about 1 $\frac{1}{2}$ million Indians had left their homeland. Many moved to other Asian countries, including what are now Sri Lanka and Malaysia. In 1947, Pakistan was created from parts of India. About 10 million people fled from one country to another. Hindus and Sikhs fled from Pakistan to India. Muslims left India for Pakistan. After East Pakistan became Bangladesh in 1971, millions more Hindus and Sikhs went to India.

The Soviet Union's invasion of Afghanistan in 1979 and 1980 caused millions of Afghans to flee. Many more Afghans left their country during the 1990's, when rival Afghan armies fought each other to gain power. By the early 2000's, about 3 million Afghans lived in Pakistan and about 2 million in Iran. Many Afghans stayed in Iran and Pakistan after Soviet troops withdrew from Afghanistan in 1989. By the late 1980's, almost 2 million refugees had fled countries of Southeast Asia because of warfare. Although many of them settled in the United States, large groups remained in Malaysia and Thailand and the other Southeast Asian lands to which they had first fled.

European Jews began to settle in what is now Israel in the mid-1800's. In 1914, about 85,000 Jews lived there. By 1948, when Israel was founded, some 450,000 more Jews had arrived, most of them from central and eastern Europe. In 1950, Israel passed the Law of Return, which allows almost any Jew to settle in Israel. Since the founding of Israel, as many as 2 $\frac{1}{2}$ million more Jews have immigrated there, chiefly from the Middle East and the Mediterranean Sea region. Immigration to Israel declined in the early 1970's. At the same time, many young Israelis emigrated. Immigration remained low until late 1989, when the number of Jews arriving from the Soviet Union rose sharply. In the following years, hundreds of thousands of Jews emigrated from Soviet and former

AP/Wide World

Jewish immigrants poured into Israel after the creation of the new state in 1948. According to Israel's Law of Return, almost any Jew may settle in the country.

Soviet lands. Many of these immigrants came after the Soviet Union was dissolved in 1991.

Africa. During the late 1800's, European powers began to carve out colonial empires in Africa. They set new boundaries for the lands of about 2,000 African ethnic groups. When Africans emigrate from one country on the continent to another, they therefore may be moving within their own ethnic group's original territory. Vast numbers of people move about on the African continent in search of better farmlands or employment opportunities. Most go to Côte d'Ivoire, Ghana, Nigeria, South Africa, Uganda, or Zimbabwe.

Colonial rule ended in most of Africa by the 1960's. Since then, civil wars in several African nations have driven millions of people from their countries as refugees. Many others have emigrated because of famine. Most of the refugees have remained in Africa, mainly in Ethiopia, Malawi, Somalia, Sudan, Tanzania, and Zaire—now Congo (Kinshasa). During the 1980's and 1990's, many Ethiopian Jews immigrated to Israel. In the early 2000's, Africa had about 6 million refugees.

Europe. During the first half of the 1900's, the Russian Revolution and two world wars caused huge population shifts within Europe as refugees fled from one country to another. Economic recovery after World War II generated a great need for labor. Many countries, including Belgium, France, the Netherlands, Sweden, Switzerland, and West Germany, sought foreigners to serve as *guest workers.* Most such temporary workers came from southern Europe and northern Africa. In the late 1970's, Greece, Italy, Spain, and Portugal drew workers from Africa and Asia.

A large number of guest workers not only remained but also brought in their families. In addition, such countries as France, the Netherlands, Portugal, and the United Kingdom received millions of immigrants from their former colonies. Europe's non-European population increased enormously. Relations became increasingly tense between native-born residents and aliens. European countries cut back guest-worker programs. They also began to review the applications of refugees more carefully and to establish stricter admittance re-

quirements for immigrants from former colonies. During the 1990's, hundreds of thousands of people from Eastern Europe, northern Africa, southern Asia, and the Middle East arrived in Western Europe. Many sought political asylum or economic opportunity. Many immigrants chose Germany because of its liberal refugee policy. As a result, Germany passed more restrictive immigration laws in the late 1990's. David M. Reimers

Related articles in *World Book* include:

Alien
Asian Americans
Assimilation
Citizenship
Colonialism (Effects of colonialism)
Culture (Contact with other cultures)
Deportation
Ellis Island
Emigrés
Ethnic group
Gentlemen's agreement
Hispanic Americans
Illegal alien
Immigration and Naturalization Service
Know-Nothings
Minority group
Nationality
Naturalization
Oriental exclusion acts
Passport
Refugee
Visa
Western frontier life in America (Building the frontier)

Outline

I. Causes of immigration
II. Effects of immigration
III. Immigration to the United States
A. The first wave
B. The second wave
C. The third wave
D. A temporary decline—1930-1945
E. The fourth wave
IV. Immigration to other countries
A. Canada
B. Latin America
C. Australia and New Zealand
D. Asia
E. Africa
F. Europe

Questions

When did Congress make it illegal to bring slaves into the U.S.?
Why did many countries of Europe seek *guest workers* after World War II?
What has long been the main reason for immigration?
What type of quotas were set by the 1990 amendments to the Immigration and Nationality Act?
Why were Chinese immigrants brought to Canada during the late 1800's?
When did the heaviest immigration take place worldwide?
What continent is replacing Europe as the major immigrant-sending area? What country is the chief receiving nation?
What is Israel's Law of Return?
Who were the *new immigrants* that began arriving in the United States during the late 1800's?

Additional resources

Portes, Alejandro, and Rumbaut, R. G. *Immigrant America.* 2nd ed. Univ. of Calif. Pr., 1996.
Sandler, Martin W. *Immigrants.* HarperCollins, 1995. Younger readers.

Immigration and Naturalization Service (INS) is a United States government agency that administers and enforces U.S. immigration laws. The agency chiefly regulates the entrance of *aliens* (noncitizens) into the United States and their presence there. A commissioner appointed by the president supervises the agency.

The United States Border Patrol, a part of the INS, helps prevent the illegal entry of aliens. The INS also works to investigate and remove aliens who entered the United States illegally or whose legal stay has ended. In addition, the INS takes part in programs to prevent people from bringing illegal drugs into the United States.

The INS also provides various immigration benefits. It processes visa claims for temporary and permanent workers, and for their immediate family members. The agency also determines the eligibility of aliens who wish to become U.S. citizens and presents those who are eligible to a federal or state court for naturalization.

Congress created the INS in 1891 as part of the Department of Labor. The agency was transferred to the Department of Justice in 1940. The INS grew significantly in the 1990's, when Congress increased funding for border enforcement and personnel.

Many critics of the INS claim that the agency fails to enforce security, maintain accurate records, and process immigration benefits in a timely manner. Calls for reform received much attention following the Sept. 11, 2001, terrorist attacks in New York City and on the Pentagon Building. Several of the terrorists responsible for the attacks were in the United States illegally or had broken the terms of their admittance. In 2002, President George W. Bush proposed moving the INS from the Department of Justice to a newly created Department of Homeland Security. B. Lindsay Lowell

Immortality is a term for the theory or belief that human life continues after death. The question of whether there is life after death has played a very important role in the philosophy and religion of most cultures. *Immortality* also means an ability to avoid death entirely.

Because the body decomposes after death, immortality requires each person to have another part, separate from the body, that survives death. In Western philosophy and religion, this nonphysical part is called the *soul* or *spirit.* It is considered the source of a person's thought and will.

People have developed a number of theories about what happens to a person's soul or spirit after death. The ancient Greeks believed that the souls of most dead people led a shadowy existence in the underworld, called *Hades.* Hindus and Buddhists believe that the nonphysical part of a person is *reincarnated* (reborn) in different forms (see **Reincarnation**). Some African societies believe that a person's soul is reincarnated in a descendant. Most Christian churches teach that souls either suffer in hell or enjoy happiness in heaven, according to their life on earth. Many Christians believe that on the last day of the world, God will raise each person's body from the dead and reunite it with its soul. God will then conduct a final judgment, take the bodies and souls of the just to heaven, and send the bodies and souls of the unjust to hell. Albert J. Raboteau

Immortelle, *IHM awr TEHL,* are flowers that retain their natural form and color indefinitely after they have been dried. The name is given to several species of flowers that are related to the asters.

Immortelle are the largest of the so-called *everlasting flowers.* Their natural color is yellow. Besides being left yellow when dried, the flowers are frequently bleached white, or dyed purple and red. Robert A. Kennedy

Scientific classification. Immortelles belong to the composite family, Asteraceae or Compositae.

W. Atlee Burpee Co.

Immortelle

Philippe Plailly/Science Photo Library from Photo Researchers

A patient without a working immune system is kept in a sterile environment to guard against disease, *above*. Normally, the immune system defends the body against disease-causing organisms. But without the protection of this system, infections that typically are not serious can be fatal.

Immune system

Immune system is a group of cells, molecules, and tissues that help defend the body against diseases and other harmful invaders. The immune system provides protection against a variety of potentially damaging substances that can invade the body. These substances include disease-causing organisms, such as bacteria, fungi, parasites, and viruses. The body's ability to resist these invaders is called *immunity*.

A key feature of the immune system is its ability to destroy foreign invaders while leaving the body's own healthy tissues alone. Sometimes, however, the immune system attacks and damages these healthy tissues. This reaction is called an *autoimmune response* or *autoimmunity*.

The immune system cannot protect the body from all diseases by itself. Sometimes it needs help. Physicians give their patients vaccines to help protect them from certain severe, life-threatening infections. Vaccines and serums boost the body's ability to defend itself against particular types of viruses or bacteria. The process of administering vaccines and serums is known as *immunization*.

The scientific study of the immune system, known as *immunology*, dates from about the late 1800's. Until then, scientists knew little about how the immune system works. Today, *immunologists*—that is, the doctors and scientists who study the immune system—are making great advances in their knowledge of how this disease-fighting system works.

G. Wendell Richmond, the contributor of this article, is Assistant Professor of Immunology/Microbiology at Rush-Presbyterian-St. Luke's Medical Center in Chicago.

Parts of the immune system

The immune system is composed of many parts that work together to fight infections when *pathogens* or poisons invade the human body. Pathogens are disease-causing organisms such as bacteria and viruses. The immune system reacts to foreign substances through a series of steps known as the *immune response*. The substances that trigger an immune response are called *antigens* (pronounced *AN tuh juhnz*). Several types of cells may be involved in the immune response to antigens. They include *lymphocytes (LIHM fuh sytz)* and *antigen-presenting cells*.

Lymphocytes are special types of white blood cells. Like other white blood cells, lymphocytes originate in the bone marrow, the blood-forming tissue in the center of many bones. Some lymphocytes mature in the bone marrow and become *B lymphocytes*, also known as *B cells*. The *B* stands for *bone marrow derived*. Some of these cells develop into *plasma cells*, which produce *antibodies*. Antibodies are proteins that attack antigens. They are carried in the blood, in tears, and in secretions of the nose and the intestines.

Other lymphocytes do not mature in the bone marrow. Instead, they travel through the bloodstream to the *thymus*, an organ in the upper chest. In the thymus, the immature lymphocytes develop into *T lymphocytes*, also known as *T cells*. The *T* stands for *thymus derived*.

Large numbers of lymphocytes are stored in tissues called the *primary lymphoid organs* and *secondary lymphoid organs.* The primary lymphoid organs are the bone marrow and the thymus, the places where lymphocytes develop. Secondary lymphoid organs include the lymph nodes, the tonsils, and the spleen. Lymph nodes are small bean-shaped organs. They are bunched in certain areas, especially the neck and armpits. Lymph nodes filter out harmful particles and bacteria from a network of vessels called the *lymphatic system.* When the body is fighting an infection, the lymph nodes may swell and become painful. See **Lymphatic system.**

Antigen-presenting cells surround foreign substances and digest them in a process called *phagocytosis* (pronounced *FAG uh sy TOH sihs).* Through phagocytosis, antigen-presenting cells engulf foreign substances and break them up into smaller pieces. The cells then *present* the fragments—which include antigen pieces—to nearby T cells. Presenting the fragments involves moving them to the surface of the antigen-presenting cells. There, the T cells can come into contact with the fragments. In some cases, an immune response will then be triggered.

The chief antigen-presenting cells include B lymphocytes, *dendritic (dehn DRIHT ihk) cells,* and *macrophages (MAK ruh fayj uhz).* Dendritic cells, which have many long armlike projections, are found throughout the body, though they are concentrated in lymphoid tissues. Macrophages are found throughout the body.

Other white blood cells that are important in fighting infections include *eosinophils (EE uh SIHN uh fihlz), monocytes (MAHN uh sytz),* and *neutrophils (NOO truh fihlz).* These cells, like antigen-presenting cells, are phagocytes *(FAG uh sytz)*—that is, they can *phagocytize* (engulf and digest) pathogens. Eosinophils play an important role in killing parasites and are associated with allergic reactions.

The immune response

There are two forms of the immune response, (1) the humoral immune response and (2) the cell-mediated immune response. They differ mainly in the parts of the immune system that are involved. Many antigens trigger both forms of the immune response.

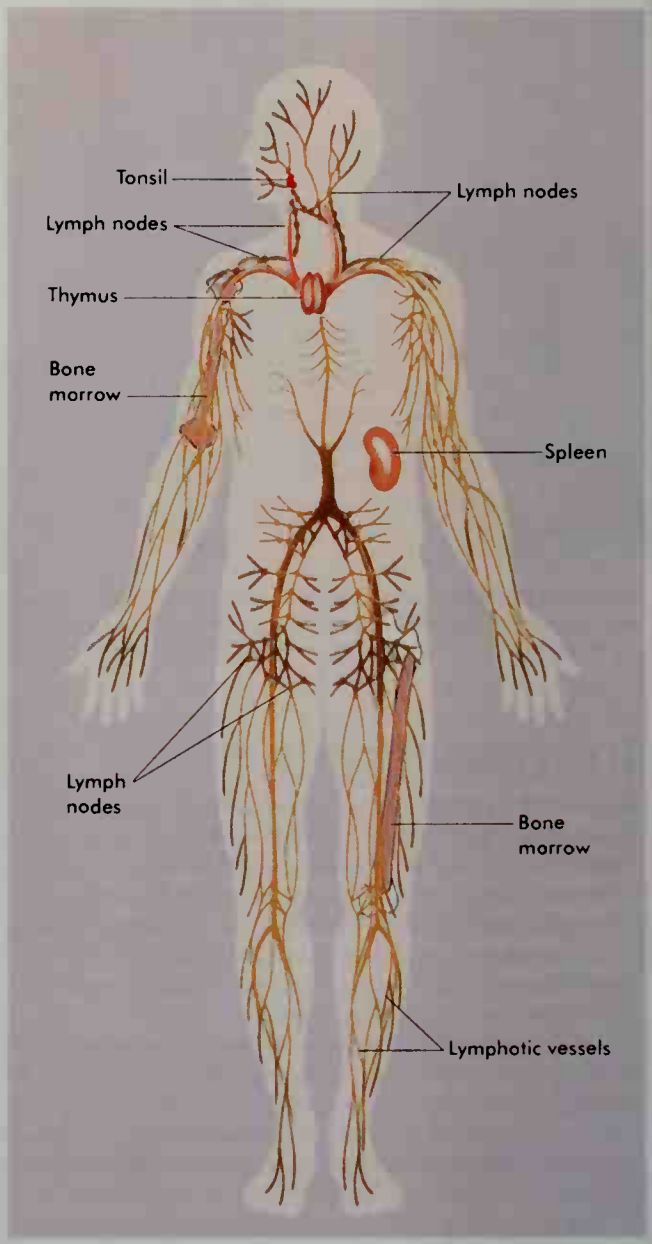
Immune system terms

Antibody is a protein that attacks foreign invaders in the body.
Antigen is a virus or other foreign substance in the body that triggers an immune response.
Autoimmune response occurs when the immune system attacks the body's own healthy tissues.
Immune response includes all the steps the immune system takes to destroy foreign invaders.
Immunity is the body's ability to resist certain diseases and poisons.
Immunization is the process of protecting the body against diseases by means of vaccines or serums.
Immunology is the scientific study of the immune system.
Lymphocyte is a type of white blood cell. There are two main types of lymphocytes, B lymphocytes and T lymphocytes.
Pathogen is a disease-causing organism, such as a bacterium or virus.
Phagocytosis is the process by which a macrophage or other cell engulfs a foreign substance and digests it, breaking it down into smaller pieces.

The human immune system

The immune system consists of many organs and tissues that work together to fight infection. Important parts of the system include the *bone marrow,* a spongy filling inside certain bones; the *thymus,* an organ in the chest; a network of vessels called *lymphatic vessels;* and small masses of tissue called *lymph nodes.* The tonsils and the spleen also play a role in immunity.

WORLD BOOK diagram by Mark Swindle



The humoral immune response, sometimes called the *antibody immune response,* uses antibodies to fight infection. The word *humoral* refers to the bodily fluids that carry the antibodies. Antibodies, also known as *immunoglobulins (ih MYOO noh GLAHB yuh lihnz),* are protein molecules produced by B lymphocytes and plasma cells. They protect the body from infection and from the *toxins* (poisons) secreted by some bacteria.

The first step in the humoral response involves the detection of an antigen by a B lymphocyte. Each B lymphocyte is highly *specific*—that is, it responds to only one particular antigen. When a B lymphocyte comes into contact with the right antigen, it attaches itself to the antigen. Then, the B cell divides into a number of

identical cells. These cells mature into either plasma cells or *memory B lymphocytes.* Plasma cells produce a large quantity of antibodies, which circulate through the lymphatic vessels and the bloodstream to fight infection. Memory B lymphocytes enable the immune system to respond more rapidly to infection if the same type of antigen is encountered at a later time. These lymphocytes are stored in the lymphoid organs until needed.

Antibodies fight infection in several ways. For example, some antibodies coat antigens to make them more easily phagocytized by macrophages and neutrophils. Antibodies also neutralize toxins from bacteria.

A number of antibodies defend the body against infection by activating a group of proteins called *complement.* Complement is found in the clear part of blood, known as *serum.* When activated, complement can assist in reactions that kill bacteria, viruses, or cells. For example, complement helps the process of phagocytosis. A bacterium is much more effectively phagocytized if it is coated with both antibody and complement rather than with just one or the other. Complement proteins can also attract disease-fighting white blood cells to an area of infection.

Like B lymphocytes, antibodies are highly specific, and each one acts effectively against only a particular antigen. For example, each type of influenza virus causes the body to produce a different antibody. The antibody that fights one influenza virus is not effective against another.

The effects of antigens on the body vary. In some cases, when foreign antigens enter the body, the body produces enough antibodies to prevent symptoms from developing. In other cases, the body does not manufacture enough antibodies to prevent symptoms, but the antibodies help the victim recover.

People's immune systems differ, largely due to heredity. As a result, individuals respond to antigens differently. For example, the immune systems of most people are not affected by pollen. But in sufferers of the allergy known as hay fever, pollen acts as an antigen and triggers an immune response.

The cell-mediated immune response occurs through the action of T lymphocytes and their chemical products. Like B lymphocytes and antibodies, T lymphocytes are highly specific and respond only to particular antigens. Two specialized proteins, the *major histocompatibility complex* (MHC) *proteins* and the *T cell receptor proteins,* help determine whether a T lymphocyte reacts to a certain antigen. MHC proteins are found on the outside surface of almost all cells. T cell receptor proteins lie on the surface of T lymphocytes.

The first step in a cell-mediated immune response involves action by macrophages or other antigen-presenting cells. After an antigen enters the body, antigen-presenting cells phagocytize the antigen and digest it into pieces called *antigen peptides.* MHC proteins bind to the peptides to form *peptide-MHC complexes,* also known as *antigen-MHC complexes.* Only certain MHC proteins can combine with specific peptides. The peptide-MHC complexes are then displayed on the surface of the antigen-presenting cells.

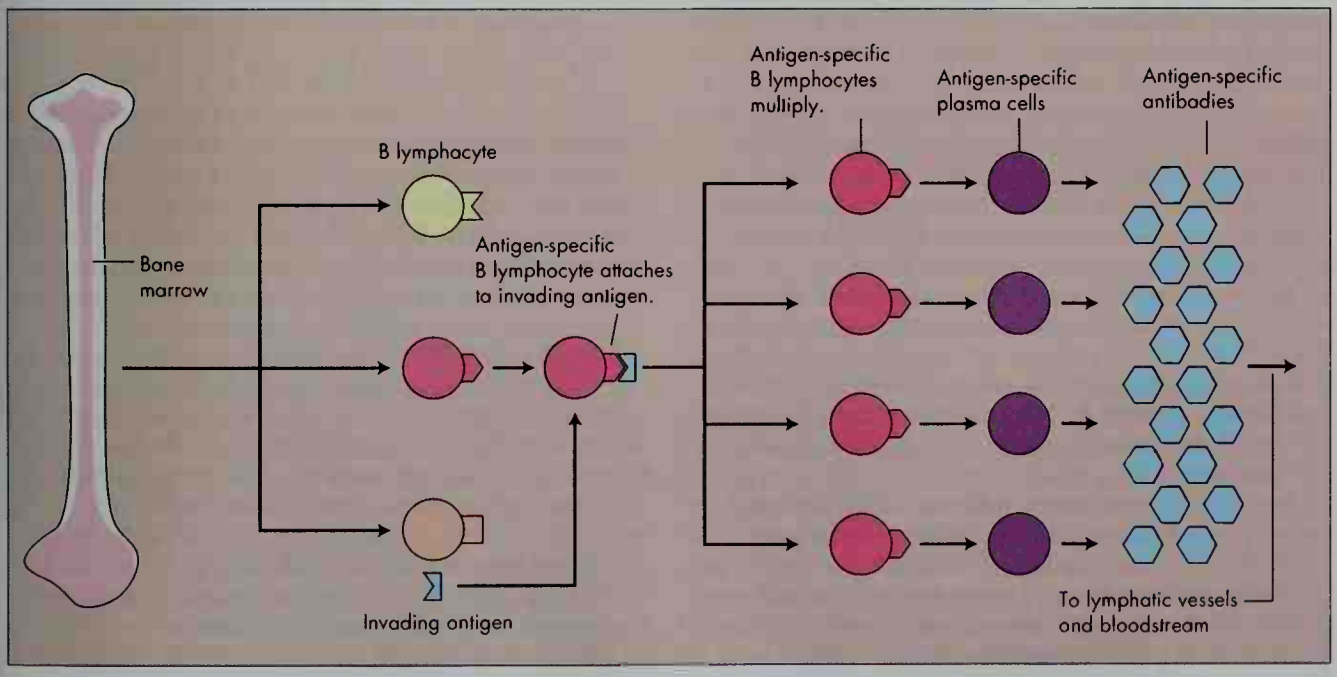
Next, T cell receptors on nearby T lymphocytes sample the peptide-MHC complexes to determine if the T lymphocytes can bind to them. Only certain peptide-MHC complexes fit particular T cell receptors, much as certain keys fit only particular locks. A proper fit of MHC complexes and T cell receptors sends the first signal for the T lymphocytes to be activated.

Activation of T lymphocytes also requires a second signal from *accessory molecules* on the surface of

The humoral immune response

The humoral immune response begins with the detection of an antigen by a B lymphocyte. B lymphocytes originate and mature in bone marrow. Each B lymphocyte responds to a particular antigen. After it attaches to an antigen, the B cells divide into many identical cells. Some of these cells mature into plasma cells. Plasma cells produce antibodies, which fight infection.

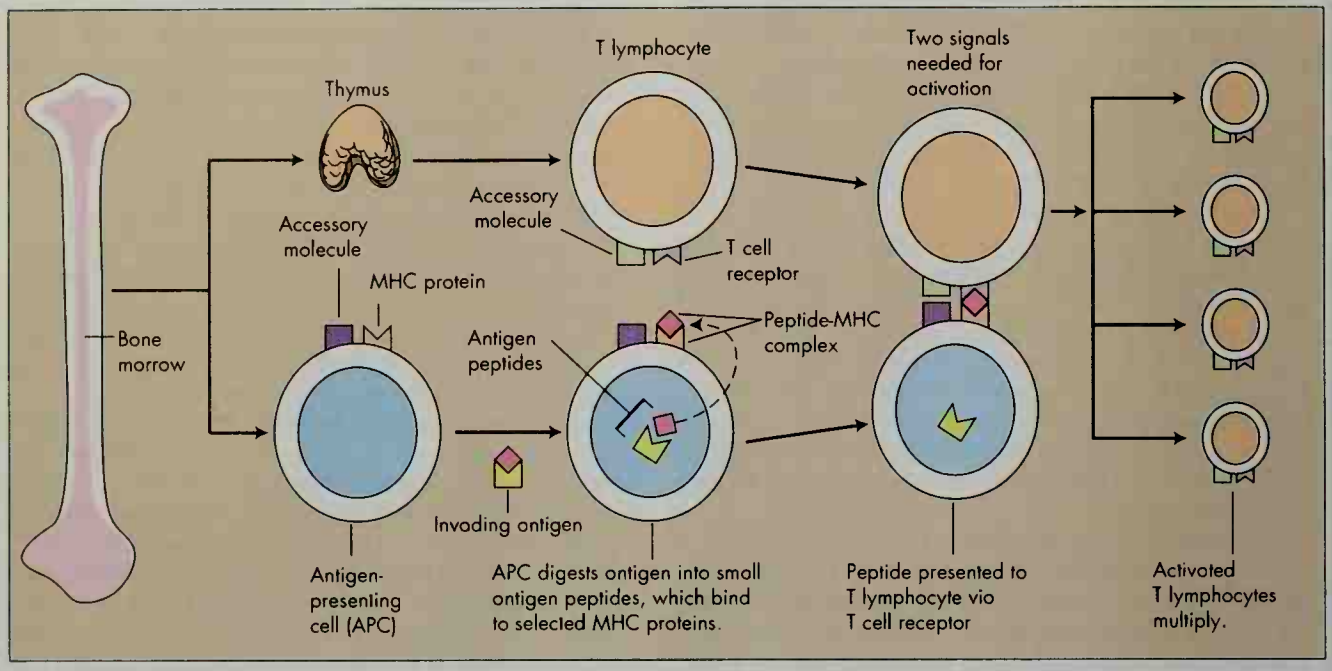
WORLD BOOK diagram by Mark Swindle



The cell-mediated immune response

The cell-mediated immune response involves T lymphocytes, which originate in bone marrow but mature in the thymus. First, an antigen-presenting cell digests an antigen into smaller *antigen peptides.* The peptides attach to major histocompatibility complex (MHC) proteins to form *peptide-MHC complexes.* Binding of a peptide-MHC complex to a T cell receptor begins T cell activation.

WORLD BOOK diagram by Mark Swindle



antigen-presenting cells and T cells. These molecules come into contact as the T cell receptors sample the peptide-MHC complexes. Only T lymphocytes that receive two proper signals—one through their T cell receptors and the other through their accessory molecules—will be activated. Upon activation, the proper T lymphocytes begin to multiply, and large numbers are released from the lymphoid organs into the bloodstream and lymphatic vessels. The lymphocytes then circulate through the body to fight the infection.

The kind of T cell that participates in a cell-mediated immune response depends on the type of antigen involved. Antigens in virus-infected cells often activate *cytotoxic T lymphocytes,* which kill the infected cell. Other antigens activate *T helper lymphocytes,* which secrete chemicals called *lymphokines (LIHM fuh kynz).* Lymphokines belong to a group of chemicals called *cytokines (SY tuh kynz).* One kind of lymphokine stimulates the production and growth of cytotoxic T lymphocytes, which kill the infected cell. Other lymphokines cause macrophages to accumulate at the infected area and help them destroy the invading organisms.

Another group of lymphocytes that defend the body against viruses and tumors are *natural killer* (NK) *cells.* NK cells differ from other lymphocytes in several ways. For example, they do not require the help of T cell receptors and peptide-MHC complexes to be activated. Instead, NK cells kill cells containing foreign substances on their own.

After the immune system has cured an infection, T cells secrete lymphokines that suppress or help shut down the immune response, and the production of the appropriate T lymphocytes stops. Many of the activated T cells die, but some are stored in the lymphoid organs, ready to fight a similar infection when needed.

The cell-mediated immune response plays an important role in the success or failure of organ transplants. Except in cases involving identical twins, who have the same genetic makeup, organ donors and recipients are genetically different. As a result, the immune system of a transplant recipient interprets the donated organ as foreign. The foreignness of the organ triggers a cell-mediated immune response, which can damage, or even cause the rejection of, the transplanted organ. To reduce the likelihood of organ rejection, therefore, physicians try to identify donors and recipients who are genetically similar. They also use drugs called *immunosuppressant drugs* that prevent an immune response from occurring or limit its activity. See **Transplant.**

How the body develops immunity

There are two kinds of immunity. They are (1) *active immunity* and (2) *passive immunity.*

Active immunity is acquired after a certain antigen enters the body either through infection or vaccination. Memory B cells and T cells will react to a later attack by such an antigen much more quickly than they did the first time. The immune response they trigger is stronger and lasts longer than the first response.

Immunity to some diseases lasts longer than immunity to others. For example, one attack of the yellow fever virus protects a person permanently from another attack. This disease is caused by a single kind of virus. On the other hand, the common cold is caused by many different kinds of viruses. Immunity to the common cold is not permanent because the body is constantly exposed to new and different kinds of cold viruses. An attack by one kind of cold virus does not provide protection against an attack by another cold virus.

Many people have an active immunity without know-

ing it. At some time, they have had a mild form of a disease. The infection may not have made them feel ill, but the body produced antibodies to fight it.

Vaccination, sometimes called *active immunization,* produces active immunity to a disease. A vaccine contains bacteria or viruses that have been killed or weakened so they produce only mild symptoms of the disease or no symptoms at all. However, the killed or weakened organisms have antigens that trigger an immune response so that the immune system will rapidly react to later attacks by the same disease-producing organisms. In some cases, a person needs a booster dose of vaccine after a time to maintain protection against the disease.

Passive immunity is generally acquired by receiving one or more injections of serum that contains antibodies for fighting a particular disease. Physicians obtain such serum—usually called an *antiserum*—from the blood of a person or an animal who has recovered from the disease or has been immunized against it. Instead of using the entire serum, doctors often use only a part of it known as *gamma globulin,* which contains most of the blood's antibodies. Gamma globulin obtained from a mixture of blood from many donors has a variety of antibodies. Physicians give gamma globulin injections to patients who cannot produce enough antibodies. Doctors also use gamma globulin to prevent such diseases as measles and viral hepatitis if a person who has not been vaccinated is exposed to the infection.

The body soon breaks down antibodies provided by passive immunization and does not replace them. As a result, passive immunity is short-lived, lasting only a few weeks to a few months. Active immunity lasts for years.

A fetus acquires passive immunity against certain diseases by receiving antibodies from the mother. These antibodies protect the baby for several months after birth. Breast-fed babies receive additional antibodies in mother's milk.

The autoimmune response

The immune response is typically directed at substances that are foreign to the body and not at the body's own tissues. Sometimes, however, the immune system attacks the body's tissues as though they were foreign. This reaction is known as an autoimmune response or autoimmunity. The autoimmune response causes several disorders that can result in severe tissue damage.

Everyone has the ability to produce *autoantibodies*—that is, antibodies that can attack their own tissues—and T lymphocytes that can do the same. However, these lymphocytes and autoantibodies are usually kept in check by cytokines produced by T cells, the failure to provide a second activating signal to T cells, and, in some cases, antibodies. As a result, most individuals do not actually develop an autoimmune disease. Scientists do not know why some people get such a disease and others do not. But they have found evidence that some people may inherit a tendency to develop an autoimmune disease.

There are two main groups of disorders caused by the autoimmune response. They are (1) organ-specific autoimmune diseases and (2) systemic autoimmune diseases.

Organ-specific autoimmune diseases involve tissue damage to individual organs, such as the thyroid gland, skin, or pancreas. For example, the autoimmune disorder Graves' disease involves the thyroid and causes the gland to become overactive. In most people with this disease, antibodies in the bloodstream react with thyroid tissue, stimulating it to grow and to produce extra amounts of thyroid hormone. The excess hormone causes a number of symptoms, including nervousness and an irregular or rapid heartbeat. The disease is commonly treated with drugs that decrease the secretion of thyroid hormone. See Graves' disease.

Systemic autoimmune diseases involve several organs. One of the most serious is systemic lupus erythematosus (SLE), pronounced *sihs TEHM ihk LOO puhs EHR uh THEHM uh TOH sihs.* It is a systemic autoimmune disease that can result in damage to the skin, kidneys, nervous system, joints, and heart. SLE involves the production of autoantibodies that combine with tissue and circulating antigens to activate complement. The activated complement produces inflammation, which damages tissues. Physicians treat SLE with aspirin, cortisone, and other drugs. See Lupus.

Disorders of the immune system

The immune system is subject to a number of disorders that disrupt its operation. Some of these conditions, such as allergies, cause great discomfort. Much more serious are the disorders called *immunodeficiency diseases,* such as AIDS (acquired immunodeficiency syndrome). These diseases can lead to death.

Allergies are mistaken and harmful responses of the body's immune system to substances that are harmless to most people. The substances that provoke an allergic reaction are called *allergens.* They include pollen, dust, mold, and feathers. Among the common allergic diseases are asthma, *eczema* (itchy red swellings of the skin), hay fever, and hives.

An allergic reaction takes place in several steps. Allergens bind to antibodies that are attached to *mast cells.* Mast cells are large cells in certain tissues of the respiratory system, the skin, and the stomach and intestines. Mast cells become activated when allergens bind to allergen-specific antibodies on their surface. When activated during an allergic reaction, mast cells are stimulated to release *histamine* and other chemicals. White blood cells called *basophils (BAY suh fihlz)* also release histamine. Histamine produces many of the symptoms normally associated with allergic reactions, such as sneezing, nasal congestion, itching, and wheezing. Consequently, physicians prescribe drugs called *antihistamines,* which counteract the effects of histamine, to reduce the symptoms of many allergic disorders. See Allergy.

Immunodeficiency diseases, also called *immune deficiency diseases,* include AIDS and severe combined immunodeficiency disease (SCID). Immunodeficiency diseases are among the most severe disorders of the immune system. People afflicted with such conditions lack some basic feature or function of their immune system. As a result, their immune system fails to respond adequately to harmful invaders. For this reason, people with immune deficiency diseases suffer frequent, and, in many cases, life-threatening, infections.

AIDS is a deadly immune deficiency disease caused by the human immunodeficiency virus (HIV). Infection with HIV results in the progressive loss of immune function. As the immune system weakens over time, individuals infected with HIV become more likely to develop illnesses that do not usually occur or that are usually not serious. These illnesses are called *opportunistic infections* because they take advantage of the weakened immune system. Eventually, the breakdown of the immune system leads to death. See **AIDS.**

Severe combined immunodeficiency disease is an immune deficiency disorder that is present at birth. It is caused by a defective gene. Infants with this condition have insufficient numbers of functioning B cells and T lymphocytes. Therefore, they lack both cell-mediated and humoral immunity. Victims of SCID develop severe infections early in life, and most die before the age of 2.

Physicians have had some success transplanting healthy bone marrow into SCID patients to supply them with normal disease-fighting blood cells. With the discovery of one of the gene defects that causes some cases of SCID, doctors hope that *gene therapy* may prove to be a way of combating the disorder. Gene therapy involves replacing the defective gene that causes SCID with a normal one. See **Bone marrow transplant; Gene therapy.**

Other problems of the immune system include deficiencies of complement proteins. These deficiencies are typically associated with an autoimmune disease, such as systemic lupus erythematosus, or with repeated cases of pneumonia, meningitis, or other bacterial infections. Physicians use antibiotics to treat the infections that occur in patients with complement deficiency.

Chemotherapy—that is, the medications used in the treatment of cancers—can also have significant effects on the immune system. In many cases, these medications diminish cell-mediated immunity as well as antibody responses. Chemotherapy may also dramatically decrease the number of white blood cells, leaving the patient vulnerable to infection.

Extensive burns or other injuries can also have severe effects on immunity, as can malnutrition. Some studies have suggested that stress can weaken the immune response and make an individual more likely to fall ill.

The study of the immune system

Early discoveries. In 1796, the British physician Edward Jenner administered the first vaccination. Jenner conducted an experiment in which he vaccinated a child with a cowpox virus to try to protect the youngster from the deadly smallpox virus. The cowpox virus and the smallpox virus are similar. Jenner's experiment worked, and vaccination against smallpox became common.

Although scientists recognized that Jenner's vaccine worked, they did not know why. They had little understanding of the immune system until the late 1800's. At that time, the French scientist Louis Pasteur showed that vaccination could be used for other diseases besides smallpox. He developed a number of vaccines, including ones for rabies and for anthrax, which is a disease that attacks livestock.

In 1883, the Russian biologist Élie Metchnikoff discovered phagocytes. In 1890, two bacteriologists, Emil A. von Behring of Germany and Shibasaburo Kitasato of Japan, identified chemicals in serum that neutralize certain toxins secreted by bacteria. They called these chemicals *antitoxins.* Antitoxins are now known to be the same as antibodies or immunoglobulins. Also during the late 1800's, the German bacteriologist Paul Ehrlich discovered that vaccines work by stimulating an antibody response in the body.

Further breakthroughs in immunology came in the early and mid-1900's. In the early 1900's, for example, the Austrian-born scientist Karl Landsteiner learned how antibodies interact with antigens. During the 1930's, Arne W. K. Tiselius, a Swedish chemist, and Elvin A. Kabat, an American biochemist, classified the proteins found in serum. They concluded that antibodies belonged to the class of serum proteins known as gamma globulin. In the mid-1960's, the American scientist Henry N. Claman and his colleagues at the University of Colorado described B lymphocytes and T cells.

In 1975, two scientists, Cesar Milstein of Argentina and Georges J. F. Köhler of Germany, reported a technique for producing *monoclonal antibodies* in the laboratory. Monoclonal antibodies are groups of identical antibodies that act against specific antigens. They can be manufactured in large quantities and have proved greatly useful in the study of immunity. They have also helped physicians diagnose certain diseases and have been used to slow the rejection of transplanted organs. See **Monoclonal antibody.**

The discovery of AIDS led to increased research on the immune system. The first cases of this deadly disease were identified in the United States in 1981, and HIV was discovered in 1983. Since then, scientists have sought to learn how HIV works against the immune system. They have also tried to develop a vaccine against the virus. These efforts have resulted in a greater knowledge of the immune system.

Will & Deni McIntyre, Photo Researchers

AIDS researchers work under a glass hood and wear protective clothing to guard against infection, *above.* AIDS research has led to an increased understanding of the immune system.

Recent advances in immunology include the identification of the genes responsible for immune functions and the discovery of T cell receptors and cytokines. For example, genetic research has uncovered the genes involved in the production of immunoglobulins. Because each antibody binds to a specific antigen, the immune system produces millions of different antibodies. Identifying the genes responsible for the production of antibodies means that gene therapy may be used someday to help individuals who lack certain antibodies.

The discovery of the T cell receptor has helped scientists understand T cell activation, creating interest among people who work with organ transplants. The ability to control the interaction between T cell receptors and T cells could lead to a greater survival rate for people with transplanted organs.

Identifying cytokines and learning how they affect the immune response has led to possible new treatments for various conditions. For example, some researchers believe that cytokines may help fight cancers. Some studies have also indicated that certain cytokines influence the function of other organ systems besides the immune system. As a result, researchers have begun to study the relationship of the immune system to other systems of the body. G. Wendell Richmond

Related articles in *World Book* include:

Biographies

Ehrlich, Paul
Jenner, Edward
Landsteiner, Karl
Metchnikoff, Élie
Pasteur, Louis
Sabin, Albert B.
Salk, Jonas E.

Other related articles

AIDS
Allergy
Anaphylactic shock
Antihistamine
Antitoxin
Arthritis
Bacteria
Blood (Protecting against disease)
Bone marrow transplant
Cancer (Cancer treatment)
Cyclosporine
Disease (Immune responses)
Gamma globulin
Gene therapy
Graves' disease
Immunization
Inoculation
Interferon
Interleukin
Lupus
Lymphatic system
Monoclonal antibody
Multiple sclerosis
Serum
Thymus
Toxin
Transplant
Tuberculosis (Primary infection)
Virus

Outline

I. Parts of the immune system
  A. Lymphocytes
  B. Antigen-presenting cells
  C. Other white blood cells
II. The immune response
  A. The humoral immune response
  B. The cell-mediated immune response
III. How the body develops immunity
  A. Active immunity B. Passive immunity
IV. The autoimmune response
  A. Organ-specific autoimmune diseases
  B. Systemic autoimmune diseases
V. Disorders of the immune system
  A. Allergies
  B. Immunodeficiency diseases
  C. Other problems of the immune system
VI. The study of the immune system

Questions

Why do people get so many colds?
What is the *autoimmune response*? What are *autoantibodies*?
What is the main way the humoral immune response differs from the cell-mediated immune response?
What are *monoclonal antibodies*? How are they used today? What do you think they could be used for in the future?
Why is it important for donors and recipients of transplanted organs to be genetically similar?
What is one way natural killer (NK) cells differ from other kinds of lymphocytes?
Why are memory B lymphocytes important?
What are the *primary lymphoid organs*? What happens in them?
What is the role of histamine in an allergic reaction?
What two proteins help determine whether a T lymphocyte reacts to a certain antigen?

Additional resources

Clark, William R. *At War Within: The Double-Edged Sword of Immunity.* Oxford, 1995.
Friedlander, Mark P., Jr., and Phillips, T. M. *The Immune System.* Lerner, 1998.
Kendall, Marion D. *Dying to Live: How Our Bodies Fight Disease.* Cambridge, 1998.
Sompayrac, Lauren M. *How the Immune System Works.* Blackwell Science, 1999.

Immunity. See Immune system.

Immunization is the process of protecting the body against disease by means of vaccines or serums. Vaccines provide immunity by causing the body to manufacture disease-fighting substances called *antibodies.* Serums furnish immunity by adding antibodies directly to the blood. There are two types of immunization. *Active immunization* involves the use of vaccines, and *passive immunization* uses serums.

Active immunization is another term for *vaccination.* A vaccine contains substances that stimulate the body's immune system to produce antibodies against a particular infectious disease. These antibodies protect the person if he or she is exposed to the actual disease-causing organism.

Vaccines contain substances that are powerful enough to trigger antibody production but that do not actually cause disease. Many vaccines consist of disease-causing bacteria or viruses that have been killed. Others consist of the live germs, but in a weakened form that does not cause the disease. Vaccines known as *toxoids* are made from poisons produced by disease-causing organisms. These poisons are chemically treated so that they provide immunity without causing disease. Still other vaccines are made from parts of disease-causing organisms. Another group consists of live organisms that resemble disease-causing ones.

Vaccines have been developed against many diseases, including chickenpox, diphtheria, influenza, measles, meningitis, mumps, pneumococcal pneumonia, poliomyelitis, rabies, rubella (German measles), tetanus, whooping cough, and yellow fever. Most vaccines are injected into the body. Sabin polio vaccine is taken orally.

A single dose of some vaccines provides lifelong protection against infection. Other vaccines require several doses to produce immunity and then must be reinforced at regular intervals with *booster doses.* Toxoids for diphtheria and tetanus are generally combined with whooping cough vaccine. Protection against measles, mumps, and rubella also may be provided in one vaccine. Most vaccines begin to provide immunity about two weeks after they are administered.

In the United States, most physicians recommend that children be vaccinated against 10 diseases—chickenpox,

Recommended immunization for children in the United States

Age	Vaccine
Birth	Hepatitis B* (Option 1)
1-2 months	Hepatitis B (Options 1 and 2)
2 months	Diphtheria, tetanus, and whooping cough†; polio; meningitis (*Haemophilus influenzae* type b)
4 months	Diphtheria, tetanus, and whooping cough; polio; meningitis; hepatitis B (Option 2)
6 months	Diphtheria, tetanus, and whooping cough; meningitis
6-18 months	Hepatitis B (Options 1 and 2)
After 12 months	Chickenpox
12-15 months	Diphtheria, tetanus, and whooping cough booster; polio; measles, mumps, and rubella‡; meningitis
4-6 years	Diphtheria, tetanus, and whooping cough booster; polio; measles, mumps, and rubella‡
14-16 years	Diphtheria and tetanus booster§
Every 10 years thereafter	Diphtheria and tetanus booster§

*The first of three doses of hepatitis B vaccine can be given at birth (Option 1) or the schedule can begin after the baby has left the hospital (Option 2).
†Diphtheria, tetanus, and whooping cough (pertussis) vaccines generally are combined in one dose of DTP vaccine.
‡Measles, mumps, and rubella vaccines generally are combined in one dose. The booster may be delayed until 11 to 12 years of age.
§Adult-type diphtheria tetanus toxoids.
Source: Centers for Disease Control and Prevention, Advisory Committee on Immunization Practices.

diphtheria, measles, meningitis caused by the bacterium *Haemophilus influenzae* type b, mumps, polio, rubella, tetanus, whooping cough, and hepatitis B. Influenza vaccine is given routinely to sick and elderly people. Other vaccines, such as those for cholera and yellow fever, are given only to persons who plan to travel to places where the disease is widespread. Vaccines for some rare diseases are given only to those who may be exposed to them.

Vaccines are safe and dependable, but they are not perfect. For example, up to 10 percent of all the people who are vaccinated against a particular disease may not be protected. In addition, vaccines occasionally produce harmful reactions in people. Sabin polio vaccine, for instance, may cause paralysis. This reaction occurs on an average of about 1 in every 2.7 million people who are immunized.

Passive immunization involves the injection of serum into the body. A serum contains antibodies that have been formed in another person or an animal. It provides almost immediate protection from infection. But this immunity lasts only a few months because the antibodies gradually disappear.

Physicians give serums to people who already have been exposed to such diseases as hepatitis, measles, rabies, and tetanus. Vaccines may work too slowly to help these patients. Doctors also use serums to protect people against diseases for which vaccines have not been developed.

Immunization and public health. Edward Jenner, a British physician, introduced vaccination in 1796 as a preventive measure against smallpox. By the late 1970's, smallpox vaccination had wiped out the dread disease.

In the United States, disease has been greatly reduced by the recommended childhood immunizations. In 1952, for example, more than 21,000 cases of paralytic polio were reported in the United States. By the end of the 1900's, fewer than 10 cases per year were reported. More than 95 percent of children in the United States receive all the recommended immunizations by the time they enter school.

Alan R. Hinman

Related articles in *World Book* include:

BCG	Jenner, Edward	Salk, Jonas E.
Immune system	Poliomyelitis	Serum
Inoculation	Sabin, Albert B.	Smallpox

Impala is an African antelope known for its swift, graceful jumping and running. Impalas may travel 30 feet (9 meters) in a leap and run 50 miles (80 kilometers) per hour. They stand from 33 to 37 inches (84 to 94 centimeters) high at the shoulder and weigh from 100 to 180 pounds (45 to 82 kilograms). Their glossy coats are mostly reddish-brown on the top and sides, and white on the tail and underparts. The males have lyre-shaped horns up to 3 feet (90 centimeters) long.

The strongest males lead *harem herds,* which consist of females and young. The other males stay together in *bachelor herds* or live alone. Impalas live in lightly wooded areas from Kenya and Uganda to South Africa. They eat fruit, grass, and leaves. Their enemies include leopards, lions, and wild African hunting dogs.

© Leonard Lee Rue III, Animals Animals

The impala is a swift, graceful African antelope that can leap as far as 30 feet (9 meters). The male impala, *shown here,* has slender, curved horns that it uses for fighting.

James M. Dolan

Scientific classification. The impala belongs to the bovid family, Bovidae. Its scientific name is *Aepyceros melampus.*

See also **Antelope** (picture).

Impatiens, *ihm PAY shee ehnz,* is the scientific name for a large group of flowering plants noted for their explosive seed pods. As a seed pod of an impatiens ripens, water pressure builds up in the walls of the pod. The slightest touch makes the walls split apart, hurling seeds in all directions. Two of the common names for certain impatiens—*touch-me-not* and *snapweed*—describe this trait.

There are about 850 species of impatiens. Most of them are native to tropical and subtropical regions of the Eastern Hemisphere. Many are found in India and

© Elizabeth Burgess, Ardea Ardea

Two common species of impatiens are the jewelweed, *left,* and the busy lizzy, *right.* The jewelweed grows wild in North America. The busy lizzy is cultivated in many gardens and is also used indoors as a potted plant.

Sri Lanka. Five species are native to North America.

Most kinds of impatiens grow wild. They can be found along riverbanks, and in lowland woods, swamps, and damp thickets. Many impatiens are cultivated in greenhouses and gardens. Some, such as the *garden balsam* and the *busy lizzy* are used as potted plants.

Most impatiens bear flowers with a long spur at the back. The flowers may be pink, reddish-orange, orange, yellow, purple, or white. The shape of the flowers varies widely. For example, wild North American impatiens, also called *jewelweeds,* have sac-shaped flowers that droop down from the stem on slender stalks. The flowers of the garden balsam, on the other hand, are roundish clusters of petals attached close to the stem.

Donna M. Eggers Ware

Scientific classification. Impatiens belong to the balsam family, Balsaminaceae. The scientific name for the garden balsam is *Impatiens balsamina.* The busy lizzy is *I. wallerana.*

See also **Plant** (picture: How seeds are dispersed).

Impeachment occurs when an authorized legislative body votes to bring a charge of serious misconduct in office against a government official. The impeached person may continue to perform the duties of office until he or she has been tried and found guilty of the charges. The term *impeachment* may also refer to the entire process by which a government official is removed from office. In this article, the term is used in the more restricted sense.

In the United States

Procedure. The House of Representatives has the sole power to bring charges of impeachment against the president, vice president, or other civilian officials of the United States government except members of Congress. A majority vote of the House is required for impeachment. The Senate then sits as a court to hear the charges against the impeached official. A two-thirds vote of the Senate is required for conviction. The vice president generally presides over the Senate. But when the Senate hears charges against the president, the Chief Justice of the United States presides. The Constitution makes this provision because the vice president would succeed to the presidency if the president were found guilty.

The Constitution specifies that officials shall be removed from office after impeachment for, and conviction of, "treason, bribery, or other high crimes and misdemeanors." Some people argue that these words mean an official may be discharged only for criminal conduct. Others claim that an official may be dismissed if he or she has displeased most of the Congress or most of the people. Congress has rejected both views. It has refused to limit the grounds for impeachment to criminal acts. However, it has refused to discharge officeholders merely because they have lost the confidence of Congress or of the people. Instead, it considers impeachable offenses to include criminal actions, serious abuse of power, and grave misconduct in office. Some scholars believe Congress requires more serious grounds to remove a president than to dismiss a judge. The president is elected for a limited term, but judges are appointed for as long as they maintain "good behavior."

Officials found guilty by the Senate may be punished by more than being removed from office. The Senate may also prohibit them from ever again holding office in the U.S. government. Conviction of impeachment charges does not involve imprisonment or a fine. However, the official may be tried in a regular court of law.

Federal judges can be tried in court for a crime while still in office. But legal scholars do not know if a president or vice president can be. One vice president, Spiro T. Agnew, was charged with a federal crime. But he resigned in 1973 after refusing to contest the charges (see **Agnew, Spiro T.**). In 1974, in the case of *United States v. Richard M. Nixon,* the Supreme Court ruled that the president could not withhold evidence demanded by a federal court. This decision meant that federal courts have jurisdiction over the president. But scholars remain undecided as to whether a president or vice president can be tried for a crime while in office.

In general, the state governments follow the same rules for impeachment as the federal government does. The lower house of the legislature votes the impeachment charges, and the upper house tries the individuals. Few states have used their impeachment power.

History. The House of Representatives has voted articles of impeachment only 16 times in the history of the United States. The Senate has convicted only seven people. Only two presidents, Andrew Johnson and Bill Clinton, have been impeached. Another president, Richard M. Nixon, resigned before the full House voted on articles of impeachment recommended against him by the House Judiciary Committee. A few other officials have resigned to avoid impeachment. However, the House can impeach a former officeholder even after he or she has resigned.

Twelve of the 16 people who have been impeached were judges, and all of the 7 convictions involved judges. The 16 cases in which the House of Representatives voted articles of impeachment were the following:

(1) Senator William Blount of Tennessee was impeached in 1797 and charged with conspiring to help British and Indian forces attack the Spanish territories of Florida and Louisiana. However, the Senate ruled that it lacked jurisdiction and dismissed the charges. This ruling established that Congress would discipline its own

members rather than use impeachment. Either house of Congress can expel one of its members by a two-thirds vote, and the Senate had expelled Blount the day after his impeachment. See **Blount, William.**

(2) John Pickering of New Hampshire, judge of the United States District Court, was impeached in 1803 for drunkenness and profanity on the bench, and for unlawful decisions. It was generally agreed that the cause of his misconduct was insanity. He was found guilty and removed from office.

(3) Samuel Chase, associate justice of the Supreme Court of the United States, was impeached in 1804 for criticizing Thomas Jefferson, who was president at the time. Some of the congressional followers of Jefferson felt that impeachment was a proper means of keeping the courts in harmony with Congress and the executive branch of government. Chase was acquitted in March 1805. His acquittal provided a significant rejection of the theory that the tenure of judges should depend on the political climate of the times. See **Chase, Samuel.**

(4) James Peck of Missouri, judge of the U.S. District Court, was impeached in 1830. A Missouri lawyer named Luke Lawless had published a newspaper article criticizing one of Peck's decisions. Peck summoned Lawless to court, committed him to prison for 24 hours, and suspended him from law practice for 18 months.

Peck was acquitted in January 1831, but the case aroused concern for the freedom of the press. Congress promptly passed a statute limiting the power of judges to punish for contempt of court except when it consists of misbehavior in the presence of the court, or so near it as to obstruct the administration of justice.

(5) West H. Humphreys of Tennessee, a judge of the U.S. District Court, was impeached in 1862 for supporting the secession movement and unlawfully acting as judge of the Confederate District Court. He was found guilty and removed from office.

(6) Andrew Johnson, 17th president of the United States, was impeached in 1868 for violation of the Tenure of Office Act, corrupt use of the veto power, interference at elections, and other high crimes and misdemeanors. The Senate acquitted him later that year. In the background of the impeachment lay a bitter difference of opinion concerning the proper treatment of the defeated Confederate states. Johnson favored a much milder policy toward the South than the one proposed by a strong group in Congress. See **Johnson, Andrew.**

(7) William W. Belknap, U.S. secretary of war, was impeached in 1876 for accepting bribes. Belknap resigned. The Senate later acquitted him.

(8) Charles Swayne of Florida, judge of the U.S. District Court, was impeached in 1904 for misconduct in office. He was acquitted.

(9) Robert W. Archbald, associate judge of the United States Commerce Court, was impeached in 1912 for entering into corrupt alliances with coal-mine owners and railroad officials while in office. Archbald was found guilty in January 1913 and discharged.

(10) George W. English of Illinois, judge of the U.S. District Court, was impeached for misdemeanors in 1926. He resigned before the trial.

(11) Harold Louderback of California, judge of the U.S. District Court, was impeached, but was acquitted in 1933.

(12) Halsted L. Ritter of Florida, judge of the U.S. District Court, was impeached and, in 1936, was removed from office.

(13) Harry E. Claiborne of Nevada, judge of the U.S. District Court, was impeached for filing false income tax returns. He was found guilty and removed from office in 1986.

(14) Alcee L. Hastings of Florida, judge of the U.S. District Court, was impeached in 1988. In 1989, the Senate convicted him of perjury and of trying to obtain a bribe, and he was removed from office. In 1992, a federal court ruled that Hastings may have been improperly tried by the Senate. Later that year, Hastings won a seat in the U.S. House of Representatives. In 1993, a higher federal court upheld Hastings' conviction.

(15) Walter L. Nixon, Jr., of Mississippi, judge of the U.S. District Court, was impeached in May 1989. Nixon had been convicted of perjury by a regular court of law and was serving a five-year sentence for the crime at the time of his impeachment. In 1989, the Senate convicted Nixon and removed him from office.

(16) Bill Clinton, 42nd president of the United States, was impeached in 1998 for perjury and obstruction of justice. The House charged Clinton with lying to a grand jury that was investigating an extramarital affair he had while in office. Other charges included hindering the investigation by lying to his aides and by encouraging others to lie and conceal evidence. The Senate acquitted Clinton in 1999. See **Clinton, Bill.**

In other countries

Canada and Australia provide that judges are to be removed by the governor-general on an *address,* or resolution of both houses of the federal legislature. The Canadian constitution gives parliament the right to impeach federally appointed judges. Judges who are found guilty are removed from office.

Other nations use impeachment in various forms. The tendency in Europe and South America is to confine impeachment to officers of ministerial rank, but to extend it to all offenses against the constitution or laws. In most nations, impeachment proceedings begin in the lower house of the legislature, and the upper house handles the trial and sentence. Roger H. Davidson

Imperial Valley is a rich irrigated region in the desert of south-central California just north of the Mexican border (see **California** [physical map]). It is below sea level, and was once a part of the Gulf of California. The Colorado River delta gradually cut off part of the gulf. The area's fertile silt soil forms the basis for agriculture. The All-American Canal brings water for about 80 miles (130 kilometers) from the Colorado River. It provides water for over 500,000 acres (200,000 hectares).

The valley is one of the country's richest farming regions. Crops can be grown there all year. Summer crops include alfalfa, cotton, and sugar beets. In winter, melons and other specialty crops are raised. Major towns include Brawley, Calexico, and El Centro. C. L. Salter

Imperialism is the policy or action by which one country controls another country or territory. Most such control is achieved by military means to gain economic and political advantages. Such a policy is also called *expansionism.* An expansionist state that obtains overseas territories follows a policy usually called *colonialism*

(see **Colonialism**). An imperialist government may wish to gain new markets for its exports, plus sources of inexpensive labor and raw materials. A far-flung empire may satisfy a nation's desire for military advantage or recognition as a world power.

The rise and decline of vast empires—such as those of Persia, Rome, Byzantium, Great Britain, and Nazi Germany—form some of the basic outlines of world history. Imperialism has been the driving force behind most wars, territorial expansion, and cultural exchange.

History. First Sargon of Akkad and then the Egyptians, Assyrians, Babylonians, and Persians established large empires from more than 2,000 to more than 4,000 years ago in the Middle East. By the beginning of the Christian era, the Romans had created a vast empire from Asia Minor to what is now France and Great Britain. The western part of the empire collapsed in the A.D. 400's, but the eastern section, called the Byzantine Empire, survived until 1453. The Byzantine Empire fell to the Ottoman Turks, who created a powerful empire that included parts of the Middle East, southeastern Europe, and northern Africa (see **Byzantine Empire; Ottoman Empire**). The western part of the Roman Empire was revived in name only as the Holy Roman Empire. It ruled much of central Europe from 962 to 1802 (see **Holy Roman Empire**). The Mongols, an Asian people, built the largest land empire in history in the 1200's. It extended from Southeast Asia to eastern Europe.

The new European nations of the 1400's and 1500's acquired colonial possessions as they spread Christianity and searched for markets and raw materials. For example, Portugal established a seagoing empire along the shores of the Indian Ocean and coasts of Southeast Asia. Spain established colonies in what is now Latin America and the southern United States. By the early 1700's, the British, French, and Dutch had colonized much of eastern North America. The Dutch gained control of the East Indies (now Indonesia), and the British began their rule of India. By the mid-1800's, many colonies in the New World had overthrown foreign rule. But Great Britain and other European powers maintained "informal empires" without actual governmental control. They did so by controlling the trade policies of some former Spanish colonies and by establishing new trade relations with African and Asian nations.

The late 1800's are often called the *Age of Imperialism.* During this period, Belgium, France, Germany, Great Britain, Italy, Portugal, and Spain divided up nearly all of Africa. European nations also took over large sections of Southeast Asia and many islands in the South Pacific. Spain surrendered Guam, Puerto Rico, and the Philippines to the United States after losing the Spanish-American War (1898). The determined pursuit of colonies and foreign trade by the major European powers strained international relations. This tension was one of the causes of World War I, which began in 1914 (see **World War I** [Competition for colonies]).

During the 1930's, Germany, under the rule of Adolf Hitler, began a program of expansion in Europe. Germany gained territory both by negotiation and by armed seizure. In Asia, Japan annexed Manchuria and waged war against China. For a brief period during World War II (1939-1945), Japan had an enormous empire in the Pacific, and Germany controlled much of Europe and North Africa. Germany and Japan were defeated in 1945 and lost their foreign territories.

Large-scale colonialism ended in the 1950's and early 1960's. European nations that were recovering from World War II had neither the money nor the will to continue the rule of colonies thousands of miles away. In addition, the people of many colonies demanded and won independence. Today, a few scattered territories, mostly islands in the Caribbean Sea and Pacific Ocean, are all that remain. However, the United States and other world powers still give economic and military assistance to former colonies. Some critics call this aid a form of imperialism. They say it can lead to indirect control of a nation's politics and economy.

Motives. Many theories attempt to explain the motives for imperialism. One of the best-known theories focuses on economic profit as the chief reason for a nation to seek foreign territories. Industrialized nations can produce more manufactured goods than their people need or can afford to buy. Colonies may serve as markets for these unsold products. They also may provide cheap land, valuable natural resources, and investment opportunities for surplus capital. However, this theory does not fully explain imperialism because many colonies were not economically profitable.

Military strategy is another important motive for imperialistic activity. Since ancient times, nations have absorbed territory near their borders to protect themselves from foreign attack. Such territory serves as a *buffer zone.* In the late 1800's, many European powers had colonies throughout the world where their ships, both naval and merchant, could take on supplies.

Imperialism can also be encouraged by patriotism, religion, and a sense of cultural and racial superiority. During the late 1800's, a strong feeling of nationalism swept most European countries. Many people believed their nation's greatness depended on the size of its territory. They encouraged expansion and the planting of their nation's flag on foreign soil. In addition, many Europeans considered the peoples of Africa and Asia to be racially inferior. The lack of industrial development in these lands reinforced this prejudice. Many expansionists thought they had a God-given mission to take new territory and to spread Christianity and the benefits of European culture.

Effects of imperialism include certain benefits that a ruling nation may provide for territories that form part of its empire. For example, the colonial powers built new communications and transportation systems, established universities, and introduced modern medical practices. However, many nations took advantage of their colonies by exporting natural resources without providing economic return for most of the people. Many colonial administrations were insensitive to local customs and destroyed old ways of life.

Allen J. Greenberger

Impetigo, *ihm puh TY goh,* is a contagious skin infection that chiefly afflicts children. The infection causes blisters filled with pus to erupt on the skin. In most cases, the blisters appear on the hands and face. They break and leave raw, red sores covered by a yellow crust. If impetigo is not treated, it may result in serious internal infections, especially in newborns.

Impetigo is caused by two kinds of bacteria—*staphy-*

lococci and *streptococci*—which grow in the pus of the blisters. Impetigo can spread through traces of pus left on towels, clothing, or other articles handled by an infected person. Physicians treat impetigo with antibiotic pills and with an antibiotic ointment that is applied to infected areas. With treatment, impetigo heals in about a week. It does not leave scars. Yelva Liptzin Lynfield

Import. See Exports and imports.

Impotence, *IHM puh tuhns,* is the inability to obtain or maintain an erection satisfactory for sexual activity. As many as half the men over age 40 may have some degree of impotence, also called *erectile dysfunction.*

A penis is usually soft and limp. Sexual excitement relaxes muscles in the organ and reduces the flow of blood from it. As a result, bodies in the penis called *corpora cavernosa* fill with blood, making the organ rigid and erect. Any condition that reduces muscle relaxation, blocks blood flow into the penis, or increases the outward flow of blood may result in erectile dysfunction.

Erectile dysfunction may be caused by tobacco use, diabetes, diseases of the arteries or other blood vessels, excess fat in the blood, surgery, or injury to the pelvis. It may result from use of certain medications, such as drugs to lower blood pressure, antidepressants, and hormone drugs. Low levels of the male hormone testosterone in the blood may also cause erectile dysfunction. In addition, impotence may have psychological causes.

To help a patient with erectile dysfunction, a doctor begins by analyzing the patient's medical and sexual history. The doctor may order laboratory testing of blood sugar, cholesterol, and testosterone levels. Some patients may undergo *arteriography,* a technique that makes arteries visible on an X-ray image; ultrasound examination to measure blood flow to the penis; or studies to monitor erections during sleep.

Treatment may involve lifestyle changes, such as reducing cholesterol levels, quitting smoking, or, for diabetics, treating high blood sugar. Physicians may prescribe testosterone for patients with low hormone levels. Other patients may use oral medications, such as sildenafil (sold under the trade name Viagra) and apomorphine, to stimulate erection. If other treatments fail, certain patients may be treated with injections to increase blood flow to the penis, or by surgically implanting a device to produce erections. Culley C. Carson

Impressionism is a style of art that presents an immediate impression of an object or event. Impressionist painters try to show what the eye sees at a glance, rather than what they know or feel about the object or incident. They try to reproduce light as it appears to the eye when reflected from the surface of things. For this reason, many impressionist paintings have an effect of vibrating brilliance. Some painters achieve this effect by applying paint in small individual strokes of pure color, instead of mixing it on the palette. There are impressionist works of music, literature, and sculpture, but impressionism is most important in the art of painting.

French impressionism. Painters and other artists have created impressionistic works of art in several periods of history. But the term *impressionism* is applied chiefly to the work of a group of French artists who revolutionized painting with shimmering, colorful pictures. These artists created their most important work from about 1870 to about 1910. They held their first exhibition together in Paris in 1874. The name *impressionism* comes from Claude Monet's painting *Impression: Sunrise* (1870), which was shown at that exhibition. The artists took the name after a critic used it mockingly to describe all the exhibited works.

Two Sisters (On the Terrace) (1881), an oil painting on canvas; The Art Institute of Chicago, Mr. and Mrs. Lewis Larned Coburn Memorial Collection

Impressionist painting emphasizes colorful, shimmering pictures of everyday life, especially informal outdoor scenes. A painting by the French impressionist Pierre Auguste Renoir, *shown here,* shows the effect of sunlight on figures and flowers.

The French impressionists were influenced by the realist movement in painting of the mid-1800's, and by the scientific study of light and color, which gained importance at the same time. Impressionists also studied the then new science of photography, along with Japanese prints, newly introduced into Europe. Both these art forms showed the impressionists how to frame and use space differently in their compositions.

The impressionists favored compositions that seemed informal and spontaneous. They preferred to work outdoors, in the natural light. Monet, in particular, often painted the same subject several times in different atmospheric situations to show how colors and surface effects change at various times of day. The impressionists painted rapidly rather than developing their paintings later in studios from studies and sketches. Most art writers of the time strongly criticized impressionist techniques, considering them evidence of sloppy workmanship. The critics considered impressionist paintings an insult to viewers because they were expected to accept apparently unfinished art as a "real" painting.

The sketchiness of impressionist painting, with its visible brushstrokes, draws the viewer's attention to the surface and technique of the artwork. The viewer thus becomes aware of the painting as an object in itself. In

this way, the impressionists prepared the way for much abstract art of the 1900's.

Today, people often think of the impressionists as painters of sunlit landscapes and rural scenes. But these artists also portrayed industrial developments they saw around them. These subjects included railway trains and stations, and factory buildings whose smoking chimneys often formed part of the landscape. They painted city life in Paris, showing people in everyday dress. Their landscapes are often set in the suburbs near Paris, where city dwellers would come for a weekend in the country.

The most important French impressionists are, in chronological order, Edouard Manet, Camille Pissarro, Edgar Degas, Alfred Sisley, Monet, Pierre Auguste Renoir, and Berthe Morisot. Pissarro and Sisley are best known for their French countryside and river scenes and their Parisian street scenes. Degas, unlike most impressionists, did not use the divided color technique. However, his scenes of ballet dancers and horse races seem spontaneous and immediate. Renoir loved to show the effects of sunlight. Morisot is known for her delicate portrayals of mothers and children.

American impressionism. Artists from other countries were part of the impressionist movement. James A. M. Whistler, while working in England and France, was one of the first Americans to emphasize delicate atmospheric effects. Mary Cassatt was an American who lived most of her life in France. She specialized in painting mothers with their children. The portraits of John Singer Sargent have a visual impact typical of impressionism. The landscapes and seashore scenes of Childe Hassam are full of vibrating sunlight.

Music, literature, and sculpture. Impressionist music is usually based on atmospheric effects or descriptive ideas. Claude Debussy and Maurice Ravel of France wrote music with sounds that call forth such images as moonlight, waterfalls, and fireworks.

In literature, impressionism means an attempt to express the immediate sensations of the world and events. Edmond de Goncourt and his brother Jules, French writers of the 1800's, were the first important impressionist writers. The American John Dos Passos sometimes used parts of headlines, popular songs, and advertisements in impressionistic passages that capture the mood and quick pace of the 1900's.

Sculptors have traditionally been concerned with showing the structural form of their subjects. Sculpture of Degas and of Auguste Rodin of France reflect impressionist qualities. Degas created sculptures as well as paintings showing ballet dancers in motion. Rodin gave his figures a look of surface movement and used extraordinary momentary poses. Ann Friedman

Each person discussed in this article has a separate biography in *World Book*. See also **Painting** (Impressionism); **Postimpressionism.**

Additional resources

Salvi, Francesco. *The Impressionists.* Bedrick, 1994. Younger readers.

Tinterow, Gary, and Loyrette, Henri. *Origins of Impressionism.* Metropolitan Museum, 1994.

In God We Trust. See National motto, U.S.

Inauguration. See **President of the U.S.** (The inauguration); **Vice President of the U.S.** (Inauguration).

Inca were a South American Indian people who ruled one of the largest and richest empires in the Americas. The Inca empire began to expand about 1438 and occupied a vast region that centered on the capital, Cusco, in southern Peru. The empire extended more than 2,500 miles (4,020 kilometers) along the western coast of South America. It included parts of present-day Colombia, Ecuador, Peru, Bolivia, Chile, and Argentina. The Inca empire was conquered by Spanish forces soon after their arrival in 1532.

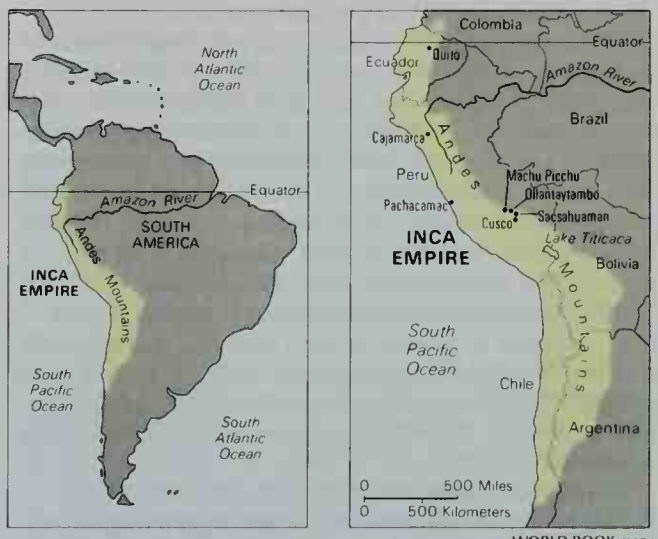
Inca emperors ruled their far-reaching territory through a complex political system. The Inca took over many areas by military force. Their political system kept a balance between the central authority of the emperor and local rulers. The name *Inca* was originally the title of the emperor. The peoples he governed had many names. But after the Spanish conquest, all people under the emperor's rule were called Inca.

The Inca were skilled in engineering and in crafts. They built a network of roads linking distant provinces of the empire, and their architecture is known for its great size and skillful construction. Inca craftworkers created fine articles from gold, silver, and other materials. The Inca also wove fine cotton and woolen cloth.

Way of life

Archaeological remains are a major source of information about the Inca civilization. The Inca did not develop a writing system, and so there are no sources about them written before the Spanish conquest. But scientists and historians have reconstructed a picture of Inca life and history from well-preserved archaeological remains in Peru. Written materials from the period of and after the Spanish conquest provide another important source of information about the Inca civilization.

Food, clothing, and shelter. The Inca used several methods to make their farms more productive, even though they did not use wheels or plows pulled by animals. They built irrigation networks in the coastal desert. In the highlands, they cut terraces into the hillsides to reduce erosion and make irrigation easier. The Inca di-



WORLD BOOK maps

The empire of the Inca lay along the western coast of South America. It included parts of what are now Colombia, Ecuador, Peru, Bolivia, Chile, and Argentina.

WORLD BOOK illustration by Richard Hook

The Inca ruled a vast, rich empire in South America. The illustration above shows an Inca emperor entering the Temple of the Sun in Cusco, the capital. The *chosen women,* who prepared food and offerings used in the ceremony, stand near the mummy of a former emperor, *left rear.*

vided their fields into three groups. The harvest of one field went to the local people. The harvests of the other two fields supported the state and state religious activities.

The main crops of the Inca were corn, cotton, potatoes, an edible root called *oca,* and a grain known as *quinoa.* Freeze-dried potatoes called *chuño* were a favorite food in the highlands. The Inca used corn to make *chicha,* a beer that was a popular beverage.

The people of each region of the Inca empire had their own clothing style. In the highlands, most clothing was made of the wool of alpacas or llamas. On the coast, cotton clothing was preferred. The nobles had garments made of fine cloth and jewelry made of precious metals. Inca men wore loincloths and tunics, plus cloaks in cold weather. Women wore long dresses and draped square shawls called *mantas* over their shoulders. Both men and women wore sandals and colorful sashes.

The Inca lived in *extended families*—that is, groups that consisted of people of more than one generation of a family. Nobles owned spacious, richly decorated stone palaces. Commoners lived in small houses that had thatched roofs. These houses were made of adobe or of stones set in mud.

Family and social life in Inca society was determined by social rank. The rank of an Inca's family determined his or her social position for life. A man's status could be changed only by performing some outstanding service for the emperor. The people were grouped in units called *ayllus,* which were based on both kinship and land ownership. The members of an ayllu owned an area of land in common. The leader of an ayllu gave each family as much land as it needed to produce its own food.

Men of noble rank could have more than one wife, and many marriages were arranged for political reasons. Emperors sometimes gave *chosen women* to favored nobles or men who had performed a service for the emperor. These women, who were selected by government officials, had great beauty and intelligence. Nobles had to marry within their own social rank, and commoners had to marry within the ayllu. Husbands and wives were expected to help each other with work in the fields and other tasks.

Inca children had little time for play because their families kept them very busy. Most children helped with the family work after learning to walk. Boys were initiated into manhood when they were 14 years old. Girls were initiated into womanhood after they started to menstruate. Boys and girls received permanent adult names during the initiation ceremonies. However, young people did not achieve full adult status until they married and started to pay taxes.

Religion played an important role in the public and private lives of the Inca. The people believed that nature was created by their most important god, Viracocha. The ruling family prayed chiefly to Inti, the sun god. Important goddesses included the earth and the sea. The

Inca believed the will of the gods could be learned through *divination,* an attempt to gain knowledge of the unknown through magic signs.

The Inca regarded many places and things as *huaca* (sacred). These included mummies of the dead and objects associated with them, plus temples, holy and historical places, springs, stones, and mountain peaks. Every household had one or more small statues of things that were huaca to the family.

The Inca made no decision, no matter how small, without divination. For example, they used divination ceremonies to guide all government decisions. The Inca also relied on divination to determine whether a certain day was good for such activities as planting crops or going to war. Methods of divination included the study of animal organs, the flames of a fire, and the movement of animals.

The Inca frequently held religious ceremonies. In Cusco, for example, priests began each day with prayers, divination, and offerings. Religious ceremonies were also held to mark important calendar events and state occasions. These ceremonies included dancing, feasts, games, songs, and parades.

Sacrifices and offerings accompanied by prayers were a main part of the Inca religious ceremonies. Crops and animals, mainly llamas, were sacrificed to keep the good will of the gods. Human sacrifices were made under special circumstances. Most people considered it an honor to be chosen for sacrifice.

Priests played a central role in Inca society. Many decisions depended on the divination ceremonies they performed. Priests also made offerings and maintained the temples. Chosen women prepared food used in religious ceremonies. These women also wove fine cloth for the royal family, priests, and persons to be sacrificed.

Inca priests treated the sick by means of curing ceremonies and often used herbs and other plants as medicine. Surgeons performed an operation called *trephining,* which involved cutting away part of the skull. The Inca believed this surgery would ease pressure on the brain or let out evil spirits. See **Trephining.**

The Inca considered funerals sacred. They believed that people lived in either heaven or hell after death. Important persons were buried above ground in stone chambers. Others were buried in pits, caves, and other types of graves.

Trade and transportation. The Inca had no system of money. They often used cloth as a medium of exchange and for gifts. The government controlled most trade, especially trade in metals, precious stones, unusual plants and animals, and other scarce items. Commoners could trade such products as crafts, foods, and textiles at local fairs.

A well-constructed network of roads connected all parts of the Inca empire. Suspension bridges spanned rivers and canyons. Parts of some roads and bridge structures still survive.

The people traveled mostly by walking, and they and llamas carried all loads. However, nobles rode on frameworks called *litters,* which were equipped with couches and carried on men's shoulders. The Inca used boats and rafts on the major rivers, on Lake Titicaca, and along the coast.

Government. The Inca empire was ruled by members of the royal dynasty. The emperor, called the *Sapa Inca,* traditionally married his sister. He chose his successor from among his sons by his sister-wife. The emperor was aided by a council of nobles who served as governors of the provinces of the empire. The emperor also consulted the chief priest, who was his brother or uncle, and the generals, who also were relatives.

The emperor was responsible for the well-being of the empire and its people. His duties included expanding the empire and making sure that the people followed the proper religious observances. The Sapa Inca also had the duty of preventing the nobles from taking advantage of commoners.

The Inca tried to keep the existing local rulers in power after conquering their territory. These rulers were allowed to govern independently as long as they did not rebel, paid taxes, and kept storehouses full of supplies. In this way, the Inca maintained strong ties within the empire.

All commoners paid taxes by doing work for the government and by giving the government a portion of their crops, livestock, or fish. The government required women to weave a certain amount of cloth. Men had to work on government construction projects, labor in the mines, or serve in the army. A group of inspectors made sure that people paid their taxes.

Communication and learning. The Inca spoke a language called Quechua. Different peoples within the empire spoke several other Indian languages. People communicated only by talking because they had no writing. Messages were relayed by messengers stationed on the roads and by fires and smoke signals.

The Inca studied the stars and planets and used their observations to predict the seasons of the year. They knew how to perform certain mathematical calculations, which they used in designing buildings, roads, and terraced fields.

Records were kept by special officials who used the *quipu,* a cord with knotted strings of various lengths and colors. Each color or knot represented a different item, and knots of varying sizes at certain intervals designated numbers.

Inca children learned by watching their parents work and imitating them. They also learned by listening to stories told by their elders. Chosen women and sons of nobles received some education. The chosen women learned to weave and make articles for religious ceremonies. Sons of the nobility went to school in Cusco for four years. They studied the Inca language, history, and religion. They also learned to use the quipu to keep records and practiced how to fight. The boys were taught by teachers called *amautas.* These men also recorded history in legends and poems that they recited from memory.

Arts and crafts. The Inca produced beautiful craftwork that ranged from images of the gods to items for everyday use by the nobles. The chosen women made fine cloth woven with elaborate geometric designs.

Inca builders became known for sturdy temples and dwellings made of stone. The large blocks of stone used for these structures were cut so finely that they fit together exactly without cement. The pottery of the Inca was beautiful and well made. Craftworkers painted it

Inca crafts

Woven fabric 38 in. (97 cm) long and 30 in. (76 cm) wide; American Museum of Natural History, New York City

An Inca poncho is decorated with small figures and geometric designs. The poncho was found on an island in Lake Titicaca in Bolivia.

Painted jar (about A.D. 1500) about 44 in. (112 cm) high; University Museum, Philadelphia

A ceramic jar was discovered at the Pachacamac ruins near Lima, Peru. The Inca used such large jars to store water and *chicha,* a beer made from corn.

Statues about 2 in. (5 cm) high; Field Museum of Natural History (WORLD BOOK photo)

Gold objects, such as these of a man and a llama, were used by the families of Inca nobles. Gold figures were placed in many Inca graves.

with geometric designs in black, brown, red, white, and yellow.

The Inca played haunting melodies on woodwinds and drums. The woodwinds included flutes and panpipes, and trumpets made of shell and ceramics.

History

Early days. Little is known about the early history of the Inca. Their legends tell of brothers and sisters sent to the earth by their father, the sun, to teach and rule the people. The Inca were originally a tribe or a group of tribes that lived in what is now the Cusco area. About 1200, they began to expand their rule over neighboring groups.

The empire. The Inca empire began about 1438, when Pachacuti, the ninth Inca ruler, put down an invasion by the neighboring Chanca confederacy. Pachacuti was the first Inca ruler to be both a military leader and an able administrator. He conquered many regions south of Cusco and rebuilt the city as the center of the empire and a monument to Inca power. He also reorganized Inca political and social life so that the empire could be managed efficiently.

Pachacuti and his son, Topa Inca Yupanqui, extended the Inca empire northwest into central and northern Peru. After Topa Inca Yupanqui became emperor, he expanded the empire southward into western Bolivia, northwest Argentina, and northern Chile; and northward into western Ecuador. After that, Huayna Capac, the son of Topa Inca Yupanqui, unified the conquered regions of highland Ecuador and parts of southern Colombia.

Huayna Capac died about 1527, and civil war broke out between the rival groups of followers of two of his sons, Huáscar and Atahualpa. Huáscar was the heir to the empire, but Atahualpa controlled a large army in Ecuador. The Inca empire was severely weakened by the

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The ruins of Sacsahuaman, an Inca fortress, lie near Cusco. Sacsahuaman was built of huge rocks, many as tall as 16 feet (5 meters). Workers hauled the rocks from quarries more than 35 miles (56 kilometers) away.

civil war, in which Atahualpa finally defeated Huáscar in 1532.

The Spanish conquest. In 1532, a short time after Atahualpa's army captured Huáscar, the Spanish explorer Francisco Pizarro met with him in Cajamarca, Peru. Pizarro was accompanied by 167 men, who ambushed and defeated Atahualpa's army. Pizarro captured Atahualpa and held him for ransom. Atahualpa paid the ransom, which was a room filled with gold and another one filled twice with silver. However, the Spaniards executed Atahualpa.

Earlier, Huáscar had been imprisoned and then killed, as ordered by Atahualpa. Therefore, the Inca had no recognized leader following the execution of Atahualpa. The Spaniards easily took over the empire.

The Inca heritage is still evident today. The Spaniards tried to wipe out all the customs of the Inca, but they could not do so.

The daily life of the Indians in the highlands of Peru and some other countries has remained much the same through the centuries. Some of the Indians speak Quechua and perform traditional curing ceremonies in treating the sick. Farming methods in the highlands also resemble those of the Inca. In addition, the Inca culture survives in the poncho and other clothing styles and in the elaborate textiles woven by the Indians of the highlands. Alexandra M. Ulana Klymyshyn

Related articles in *World Book* include:

Atahualpa
Cusco
De Soto, Hernando
Ecuador (Indian period)
Indian, American
Machu Picchu
Peru
Pizarro, Francisco

Additional resources

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Incandescent lamp. See Electric light.

Incense is a mixture of sweet-smelling gums and balsams. It burns with a delicate fragrance. People sometimes add sandalwood and other substances to incense to produce special scents. Usually incense is made in powder form or in sticks. The ancient Egyptians burned incense at religious ceremonies. The Greeks and Romans and later the early Christians adopted this practice. The burning of incense is still part of the ritual of the Eastern Orthodox Churches, the Roman Catholic Church, and some of the Episcopalian churches. Buddhists also burn incense during religious ceremonies. Patricia Ann Mullen

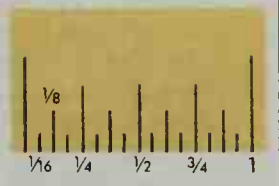
See also Censer; Frankincense.

Incest. See Marriage (Marriage in other cultures).

Inch is the smallest unit of distance in the inch-pound system of measurement customarily used in the United States. There are 12 inches in one foot and 36 inches in one yard. Any distance smaller than an inch is measured in fractions of an inch. The metric system measures short distances in *centimeters* or *millimeters.* One centimeter equals 10 millimeters. The inch equals exactly 2.54 centimeters. The symbol for the inch is ". Richard S. Davis

The length of the inch, originally laid down in a statute by Edward II in the early 1300's, equaled three grains of barley laid end to end. It was divided into three parts called barleycorns.

The inch became the smallest unit of distance in the inch-pound system of measurement used in the United States. Here, it is divided into 16 parts, measured as fractions of an inch.



WORLD BOOK illustrations by Sarah Woodward

Inchcape Rock is a dangerous reef in the North Sea, off the coast of Scotland. It is 16 miles (26 kilometers) from the entrance to the Firth of Tay. According to a Scottish legend, a monk once placed a bell buoy over the rock to warn settlers. A pirate cut the bell free. Later, his ship was sunk when it struck the rock. The British poet Robert Southey retold this legend in his ballad "The Inchcape Rock." Inchcape Rock is often called *Bell Rock.* A. S. Mather

Inchon, *ihn chahn* (pop. 1,817,919), is a major industrial city in northwestern South Korea and the nation's second largest port. Only the port of Pusan is larger. Inchon lies on the Yellow Sea, about 20 miles (32 kilometers) southwest of Seoul, the capital (see **Korea** [map]).

Inchon's industries include fishing, shipping, and the manufacture of chemicals, iron, steel, and textiles. The port can accommodate about 30 large ships at one time. Inchon is linked to Seoul by a railroad, a subway system, and a modern highway. Inchon International Airport began operating in 2001.

In ancient times, Inchon was a small fishing village. Inchon developed into a major port after foreign nations forced Korea to open the city and other port cities to international trade in the 1880's. In 1950, during the Korean War, United States troops made a surprise landing at Inchon. After the landing, United States forces turned back North Korean troops who had invaded South Korea (see **Korean War** [The Inchon landing]). Inchon began to develop into a major industrial center in the late 1960's. Hundreds of factories have since been built in the city and the surrounding area. Inchon's population has soared since the industrial boom began. A housing shortage and pollution problems have developed. Chong-Sik Lee

Inchworm. See Measuring worm.

Incinerator is a furnace that burns waste materials to destroy them or reduce their volume. Incinerators range in size from household-refuse incinerators, frequently found in apartment buildings and businesses, to huge *municipal* (city) or industrial incinerators.

Large incinerators are used mainly to lessen the volume of material disposed of in *landfills,* where waste is

deposited and covered with dirt. Many communities are running out of landfill space. Incinerators are also used to destroy harmful chemicals and disease-causing germs in certain types of waste materials.

There are four main categories of large incinerators, based on the type of waste material they burn: (1) *hazardous waste* (harmful chemical or metal waste) produced mainly as a by-product of industrial processes, (2) municipal waste, (3) medical waste, and (4) sewage *sludge* (muddy deposits). Industrial hazardous waste includes polluted wastewater, explosive or flammable substances, and other by-products contaminated with toxic substances. Municipal waste incinerators burn refuse collected by cities or waste-management businesses. Medical waste incinerators dispose of infectious waste and other burnable rubbish generated by hospitals. Sewage sludge incinerators burn sludge produced by plants that purify water from sewers and drains.

Large incinerators heat waste to up to 2000 °F (1100 °C), hot enough to break down toxic *organic* (carbon-containing) chemicals into less harmful gases and water. The heat also sterilizes infectious waste. Many newer incinerators use the heat from burning waste to produce steam, which then can be used to heat buildings or to generate electric power.

Many people oppose the use of incinerators because they can produce air pollution. The exhaust from incinerators contains gases and ash with small amounts of metals and other air pollutants. The exhaust may also contain small amounts of extremely toxic chemicals called *dioxins*. To help control pollution, newer incinerators often use *scrubbers*, devices containing chemicals that remove acid gases by soaking them. Also, cleaners called *baghouses* work like a large vacuum cleaner and catch particles of ash before they get to the incinerator stack. However, some critics say that the reduced amounts of pollutants released by newer incinerators are still unsafe.

The United States Environmental Protection Agency (EPA) sets standards for how much pollution can come out of an incinerator stack. The EPA also develops guidelines that states can use to determine whether to grant operating permits to incinerator owners.

Larry R. Waterland

See also **Hazardous wastes; Waste disposal.**

Inclined plane is a device used to raise heavy loads with relatively small forces. For example, pushing a load up a ramp onto a platform requires less force than lifting the load onto the platform, because the load travels farther. Suppose the platform is $3\frac{1}{2}$ feet high, the ramp is 14 feet long, and the load is a 200-pound barrel. The work required to lift the barrel onto the platform equals load times height, or $200 \times 3\frac{1}{2}$, which equals 700 foot-pounds. But if the load is rolled up the ramp, the force required is:

$$\text{Force} = \frac{\text{load} \times \text{height}}{\text{distance}} \quad \text{or} \quad F = \frac{200 \times 3\frac{1}{2}}{14} = 50 \text{ pounds}$$

Although using the inclined plane reduces the force, the amount of work done remains 700 foot-pounds (50×14). The inclined plane is one of the six simple machines (see **Machine** [Six simple machines]).

James D. Chalupnik

Inclinometer is a device for measuring angles formed with the plane of the horizon. It may be a magnetic needle used to measure the angle between that plane and the earth's magnetic field. Or it may be a mechanical device used to measure the angle to an aircraft.

Income is a term in economics that generally is defined in terms of consumption and wealth. From this standpoint, income is the total value of goods and services a person can buy during a certain period with no loss of wealth. Wealth consists of such assets as investments and property. Income includes interest and other returns from the lending of wealth, but income is not wealth.

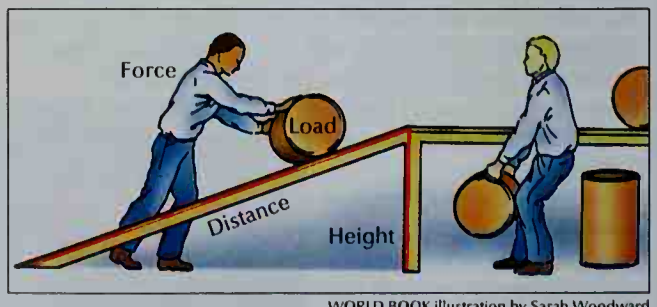
Income is received in the form of money or as items called *imputed income*. Such items include free room and board, and food raised at home. This article deals mainly with income in the form of money.

In the economy of a small community or of an entire nation, one person's consumption creates another's income. When a consumer buys $100 worth of goods or services, the producer receives $100 of income. The producer, in turn, may use this money for other purchases, thus providing someone else with income.

Types of income

Economists classify income in various ways. For example, *personal income* is the total income received in a nation during a certain period, except for the income of corporations. Personal income includes the income of individuals, nonprofit institutions, and unincorporated businesses. *Business income* is the income received during a specific period by the corporations in a country. *National income* is the total of all income in a nation during a set period. This type of income is calculated by subtracting the cost of *depreciation* (the reduction in the value of equipment over time) and certain business taxes from the *gross national product* (GNP). The GNP is the total value of goods and services produced by a nation in a specified period.

Economists sometimes measure income by comparing *gross income* to *net income* and *money income* to *real income*. Gross income is income before taxes and other expenses have been deducted. Net income is what remains after deducting all such expenses. Money income is the value of an income in dollars or some other currency. Real income measures *purchasing power*, the amount of goods and services that can be bought with a specific money income. Real income changes according to changes in money income or in the prices of goods and services, or both. If, during a period of inflation,

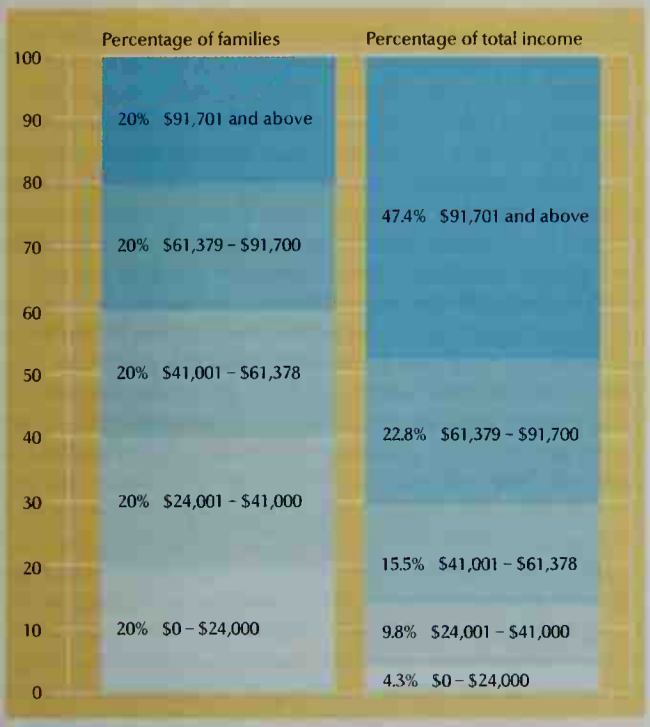


WORLD BOOK illustration by Sarah Woodward

The inclined plane made by a ramp makes it easier to roll a barrel onto a platform than to lift it.

Distribution of U.S. family income

The graph on the left divides all U.S. families into five equal-sized groups according to income. The graph on the right shows how much of the nation's total family income each group earns.



Percentages in the graph on the right do not total 100 due to rounding. Figures are for 2000. Source: U.S. Census Bureau.

prices rise faster than money income, real income decreases and a given amount of money buys fewer items.

Sources of income

Economists divide income sources into two categories based on *earned income* and *unearned income*.

Sources of earned income consist chiefly of wages and salaries. Earned income is received in return for labor. It makes up about two-thirds of the national income of the United States. Wages are generally paid according to the number of hours worked or the amount of labor produced. Salaries are payments that remain fixed for a certain period, such as a year.

Sources of unearned income include interest, profits, and rent. Unearned income is received in return for the use of resources other than labor. About a third of the U.S. national income consists of unearned income. Interest is a payment to lenders for the use of their money. Banks and other financial institutions pay interest on savings accounts, and corporations and governments pay interest on bonds. Profit is the income received by a business after all costs of production have been paid. Rent is payment received for the use of buildings or other property. Other sources of unearned income include gifts, inheritances, and certain *transfer payments*. Transfer payments involve no production of goods or services. They include unemployment benefits, welfare payments, and grants.

Distribution of income

In the United States, family income ranges from almost nothing to more than $1 million a year. Suppose all American families were divided into five equal-sized groups according to income. Families in the lowest 20 percent income group would receive a little more than 4 percent of the nation's total personal income. Families in the top 20 percent would receive more than 45 percent. This unequal distribution would result partly from differences in ability, ambition, and inherited wealth. Other factors include illness and racial or sexual discrimination.

In the world. In general, personal income is distributed less equally in the poorer nations than in the wealthier ones. Among countries with similar wealth, income distribution generally is more equal in socialist nations than in nonsocialist societies. The distribution of total personal income among all the nations is extremely unequal. For example, the United States had a *per capita* (for each person) GNP of about $35,500 in 2001. For the same period, most developing nations had a per capita GNP of less than $3,000, and many had a per capita GNP of only a few hundred dollars.

Redistribution of income. In many countries, the government redistributes income to lower-income groups through transfer payments financed by taxes on people with higher incomes. In the United States, the federal government makes transfer payments in such forms as cash, food stamps, and free or inexpensive medical services.

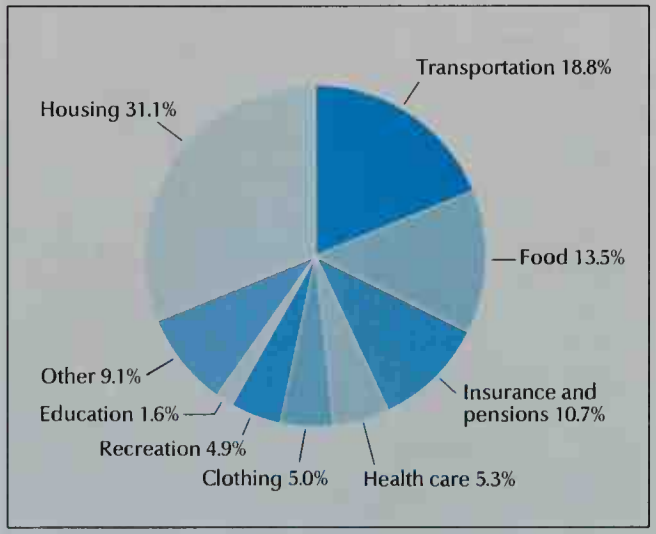
Inflation also affects the distribution of income, especially among people who live on fixed incomes from pensions, welfare payments, or other sources. When prices rise, these people cannot buy as much as before. When wages rise, fixed incomes make up a smaller proportion of the national income.

Uses of personal income

People use personal income to buy goods and services, to pay taxes—mainly income taxes—and to make investments. In the United States, many people pay local, state, and federal income taxes. The majority of people with higher incomes pay a larger share of their income in taxes.

A U.S. family budget

This graph shows how an average family in the United States spends its annual income. Reliable data for savings contributions and other nonretirement investments are not available.



Figures are for 2000. Source: U.S. Bureau of Labor Statistics.

Income that remains after all taxes and government fees have been paid is called *disposable income*. Most Americans spend about 90 percent of their disposable income on goods and services, including three basic needs—food, clothing, and shelter. Income left after paying for these basic needs is called *discretionary income*. People spend their discretionary income on such items as entertainment and education. As income rises, consumption and investment both increase. People with higher incomes invest a larger part of them than do those with lower incomes.

Income growth

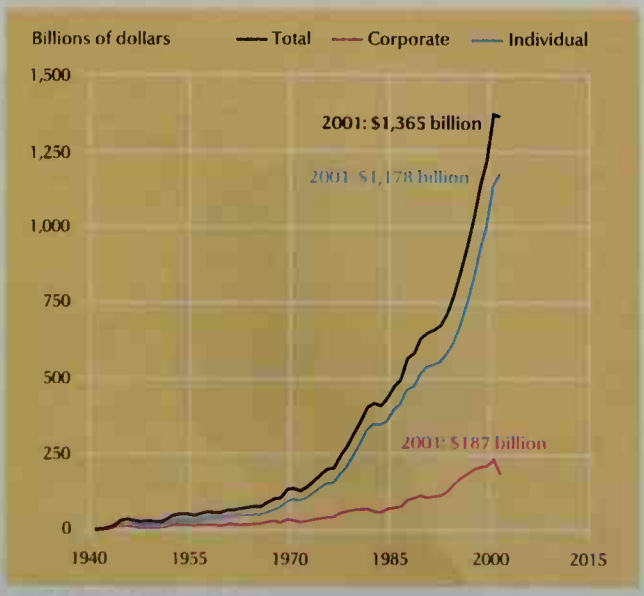
During the history of the United States, real income per person has increased by an average of about 2 percent annually. Thus, today's real income per person is approximately 2 $\frac{1}{2}$ times as large as the real income per person of about 1950. Income growth provides higher living standards for many people through increased production and consumption. But it also has harmful effects. In many cases, for example, the growth of income through industry has polluted the environment, destroyed natural beauty, and threatened life. Some people believe income growth should be slowed or even stopped. They point out that greater consumption may not bring greater happiness. Others argue that industry's harmful effects can be controlled through improved technology. Paul Taubman

Related articles in *World Book* include:

Budget	Income tax
Careers (graph: Annual starting salaries in the U.S.)	Inflation (Effects on income)
	Interest
Consumption	Investment
Economics (Distribution of incomes; graph: Family income in the United States)	National income
	Profit
	Wages and hours

Income tax is a tax on the earnings of individuals and corporations. Nearly all nations levy income taxes to pay for their government programs. Such taxes may be levied by the federal government, state or provincial governments, and even some local governments.

Revenue from U.S. federal income taxes



Source: U.S. Internal Revenue Service

The United Kingdom was the first country to collect a general income tax. The government enacted the tax in 1799 as a temporary measure to help pay the costs of the Napoleonic Wars. Many countries enacted income taxes from time to time during the 1800's to help meet unusual expenses, such as wars. The income tax came into wide permanent use during the early 1900's.

In countries where most people work for wages or salaries—including Canada, the United Kingdom, and the United States—the individual income tax raises more money for the government than any other source of revenue. In countries where most people are self-employed in agriculture or service industries, such as India and Malaysia, individual income taxes provide a much smaller part of the government's revenue.

Many people have questioned the fairness of the income tax, its effect on economic activities, and how complicated it has become in many countries. Some people have even called for its elimination. But the income tax will likely remain an important part of most countries' tax systems.

Types of income taxes

The two major kinds of income taxes are *individual income taxes* and *corporate income taxes*. Individual income taxes, also called *personal income taxes*, are levied on the income of individuals. Corporate income taxes are applied to the earnings of corporations.

An income tax may be either *progressive* or *proportional*. Under a progressive income tax, the more *taxable income* a person earns, the higher percentage of taxes he or she owes. Taxable income is the amount left over after certain items have been subtracted from total earnings. For example, a person with a taxable income of $10,000 may pay a tax of 20 percent of that income, or $2,000. But a person whose taxable income is $20,000 may pay a tax of 25 percent of that income, or $5,000.

Under a proportional income tax, people pay the same percentage of tax for all levels of taxable income. For example, under a proportional tax rate of 20 percent, a person whose taxable income is $10,000 must pay a tax of 20 percent of that income, or $2,000. A person with a taxable income of $20,000 must also pay a tax of 20 percent of his or her income, or $4,000.

Current issues

The fairness and structure of income tax systems are the subject of frequent debate. Many people and governments favor the use of progressive income taxes because they believe income taxes should be based on a person's *ability to pay*. Moreover, they believe that people with large incomes have the ability to pay more taxes as a percentage of income than people with smaller incomes. Debates often arise, however, over the definitions of such terms as taxable income. Other current issues concern the effect of inflation on income taxes and the effect of taxes on the economy.

Defining taxable income. To levy an income tax, a government must define taxable income. Taxpayers are allowed to subtract certain expenses in figuring their taxable income. These expenses are referred to as *deductions* in the United States and as *allowances* in the United Kingdom and other countries that use British English. In many countries, for example, charitable con-

tributions, a percentage of medical expenses, and contributions to private pension funds or certain kinds of savings plans may be deducted. Some countries, including Germany, Japan, and the United States, allow certain taxpayers to deduct state and local taxes.

Nearly all countries permit taxpayers to deduct from taxable income expenses necessary to the earning of income. But it is often difficult to determine what constitutes a necessary expense. For example, the cost of a business trip may be a necessary expense and, therefore, a legal deduction. But should a taxpayer be allowed to deduct the cost of a luxurious hotel room if less expensive lodgings were available?

Some political leaders have proposed eliminating most or all deductions and other adjustments of taxable income. When such a tax plan also has a proportional rate structure, it is often called a *flat tax.* Some people believe that adopting a flat tax would eliminate many unfair deductions and simplify tax returns. Opponents of the flat tax say that it would cause the middle class to pay too much, and the rich to pay too little. See **Flat tax.**

In some countries, serious problems arise over the taxation of *capital gains.* Capital gains are the profits earned from the sale of stocks, real estate, or other income-producing property. Some people believe low capital gains rates strengthen the economy by encouraging investment. Others believe low rates provide a loophole for wealthy taxpayers. See **Capital gains tax.**

Effects of inflation. Most countries' tax systems are designed to be progressive—that is, to tax large incomes at a higher rate than small incomes. Many people are concerned about the influence of inflation on progressive income taxes. This concern arises because an increase in people's income during a period of inflation does not necessarily mean an increase in their wealth. For example, if prices generally rise 10 percent and a worker receives a 10 percent raise, the worker can buy only as much as he or she could buy before the inflation occurred. But under a progressive income tax, such a raise may cause the worker's income to be taxed at a higher rate even though the worker's buying power has remained the same. This is known as *bracket creep,* because inflation pushes people into higher tax brackets.

To solve this problem, governments in some countries adjust their tax rate schedules based on changes in prices for certain items. This is known as *indexing* the tax system for inflation. This method of adjustment helps keep inflation from causing people to pay more in taxes.

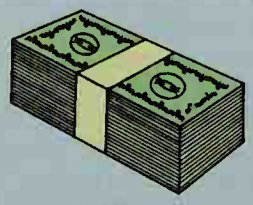
Inflation can also cause an income tax system to make mistakes in measuring the real *return* (profit) someone has earned on an investment. For example, consider what happens if an individual buys a share of stock for $100, holds it for one year, and sells it for $110. Under the income tax system of many countries, including that of the United States, selling the stock would mean that the individual owes tax on the $10 increase in the stock's value. If prices rose by 10 percent during the year, however, the stock price has merely kept up with inflation. In other words, it is not worth more when it is sold than when it was purchased. In this case, the tax system overestimates how much the individual profited.

The same problem arises with interest payments and receipts, because part of the interest earned is only keeping up with inflation. Eliminating bracket creep does not address this problem, and fixing it would require much more complex adjustments.

Income tax complexity. Many people are concerned the income tax system in many countries has become too complex. Even tax professionals can find it difficult to

How a wage earner pays income tax

WORLD BOOK diagram



Total income

↓

Minus exclusions

Exclusions include such types of income as loans, gifts, and most Social Security payments.

↓

Gross income

↓

Adjusted gross income

Certain other expenses, such as some moving costs, are subtracted from gross income to determine the taxpayer's adjusted gross income.

↓

Minus deductions

Deductions are such expenses as medical bills and interest payments that may be subtracted from adjusted gross income.

Minus exemptions

Exemptions are set dollar amounts that are not taxed. They are allowed for each of the taxpayer's dependents.

↓

Taxable income

The tax rate is applied to *taxable income,* the amount left after all exclusions, deductions, and exemptions have been subtracted from total income.

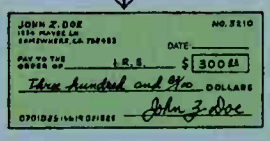
↓

Gross income tax payable

↓

Minus credits against tax

↓



Income tax payable to the federal government

figure how much individuals owe. Many people also complain that filing tax returns takes too long, costs too much money, and causes too much stress. Many people find that their financial situation becomes more complicated over time. For example, they may invest in the stock market or start their own business. Such changes force taxpayers to deal with aspects of the tax law that are new to them.

Another cause for complexity is that governments use the tax system to promote social programs that have little to do with raising revenue. For example, tax deductions for charitable contributions are designed to encourage people to donate money to charitable organizations. Requiring people to keep records about their donations makes the tax system more burdensome. Proposals that eliminate all deductions—such as the flat tax—would simplify the tax system. But they would not allow governments to use the tax system to encourage activities deemed worthy of special tax treatment.

Effects on the economy. Economists disagree about the effect of income taxes on such economic activities as personal saving, investment, and work effort. Some economists think income taxes limit economic growth. They argue that an economy needs investment to grow, but the income tax causes people to save less and businesses to invest less. Some experts also claim that progressive income taxes discourage taxpayers from working hard to earn additional income because that income would be heavily taxed. But other economists doubt that income taxes have a large effect on savings, investment decisions, or work effort.

There is no doubt, though, that the income tax has an impact on certain choices that people and businesses make. For example, there is wide agreement that the deduction for charitable contributions encourages people to donate money. Also, when tax rates are about to go up, people sell stocks and cash in stock options that have increased in value so that the income will be taxed at the lower rate. There is also some evidence that some couples who will have to pay higher income taxes after they marry postpone their weddings. Also, some families plan to have children before a new year begins to claim the deduction for that year.

Federal income taxes in the United States

Most individuals and corporations in the United States must pay federal income taxes. Some individuals and businesses do not have to pay income taxes or are taxed at special rates. For example, a person may earn so little money that he or she has no taxable income. Such nonprofit groups as charitable organizations and churches may pay no income tax or be taxed at low rates. Special tax rules also apply to the income of insurance companies, banks, and some other corporations.

United States income taxes, like those of most countries, are progressive taxes. There are six federal individual income tax rates ranging from 10 percent to almost 40 percent of taxable income. The corporate income tax rate ranges from 15 to 35 percent. Many people and businesses also pay separate taxes on wages to help finance Social Security programs. These are known as *Social Security contributions* or *payroll taxes.* See Social security (Financing Social Security).

Figuring the individual income tax. To determine income subject to tax, taxpayers first total their wages and salaries, taxable interest, dividends, capital gains, rent, royalties, and other kinds of income. Some types of income, called *exclusions,* are not taxable. Exclusions include interest on certain state and municipal bonds, gifts, inheritances, veterans' benefits, welfare benefits, compensation for sickness or injuries, and certain Social Security payments. Also, employee pension contributions and health care benefits are not counted as income. The taxpayer may also subtract some business expenses and moving costs, and contributions to certain retirement accounts. The result of these calculations is called the *adjusted gross income.*

Next, the taxpayer claims any deductions. For example, home mortgage interest payments, state and local taxes, charitable contributions, and a percentage of medical expenses may be deducted. If total deductions fall below a set amount, the taxpayer may still deduct this amount, which is called the standard deduction.

Taxpayers may also claim *exemptions,* set amounts that are subtracted from adjusted gross income. Taxpayers may claim one exemption for themselves, for their spouse, and for each dependent. The exemptions are reduced or eliminated at higher income levels. *Tax credits* also may be subtracted from tax due. These credits are designed to provide relief from income tax to special groups of people, such as low-income families.

In general, taxpayers fit into four categories for filing purposes: (1) single people; (2) married people filing jointly—that is, a married couple who pay one income tax on their combined income; (3) married people filing separately—that is, the husband and wife each pay a separate income tax; and (4) *heads of households* (single taxpayers who maintain a household for a certain other person or persons). Taxes differ for all four groups.

Paying the individual income tax. Some individuals, including the self-employed, pay their income tax directly to the government. But for those taxpayers who work for a salary or wages, their employers withhold tax from each paycheck and send the money to the Internal Revenue Service (IRS). This government agency is responsible for collecting most federal taxes.

Each year, taxpayers fill out a tax return. They state how much taxable income they received in the previous year and how much they have already paid in withholding tax. If, according to the tax rate schedule, they have paid too little tax, they send the additional money to the IRS. If they have overpaid, they receive a refund from the government. Most taxpayers receive a refund.

The law requires most people to submit their tax return for the year by April 15 of the next year. Those who owe additional tax money must send their payment by April 15. If they do not do so, they must pay a fine, plus interest on their late payment. Many people send their returns to the IRS by computer or by telephone.

In addition to their regular tax return, many taxpayers must fill out an estimated tax return for the coming year and send it to the IRS by April 15. Taxpayers must file such a return if they estimate that (1) their taxable income for the year will be above a certain level, and (2) their withholding taxes for the year will not cover the total tax they will owe. For example, they may have to file an estimated tax return if they will receive considerable taxable income from which no withholding taxes will be

collected. In an estimated tax return, taxpayers estimate their taxable income for the coming year and determine how much tax they will owe. They subtract the withholding taxes they will pay from the total tax they will owe. The difference is their estimated tax. They may pay this tax in one sum or in quarterly payments. Taxpayers who make late payments or underestimate their tax by an excessive amount must pay a penalty.

Processing income tax returns. The Internal Revenue Service uses computers to process income tax returns. The IRS computer system consists of service centers linked electronically with the National Computer Center in Martinsburg, West Virginia. The IRS handles over 100 million individual tax returns each year.

Each individual tax return is checked for mistakes in arithmetic and for failure to report such income as dividends from stock or interest received from banks. The computers compare each taxpayer's return with the IRS records on that person. Disagreements between taxpayers and the IRS are handled by the U.S. Tax Court. People who try to evade the tax by underreporting income or exaggerating deductions may receive stiff penalties, including prison terms. See **Tax Court, United States.**

State and local income taxes

Many state governments levy individual and corporate income taxes, and many local governments also collect an individual income tax. In some states, corporate and individual income taxes are the chief source of revenue for the state.

State and local income tax rates are lower than the federal rates, with tax rates that are either progressive or proportional. In most communities that have a local income tax, the tax rates are proportional. Some communities levy an income tax on all people who work in the community, including those who do not live there.

History of U.S. income taxes

Some states levied an individual income tax before 1850. The federal government first collected an income tax in 1863. Congress had passed individual income tax laws in 1861 and 1862 because the Union government needed revenue to pay the cost of the American Civil War (1861-1865). The tax ended in 1872. Congress passed another income tax law, in 1894, but the Supreme Court of the United States declared it to be unconstitutional. The court based this decision on a statement in the Constitution that any tax levied directly on individuals must be levied in proportion to a state's population.

In 1909, Congress passed a law providing for a kind of corporate income tax. The Supreme Court declared the law constitutional. To avoid future adverse court decisions, backers of an individual tax worked to amend the Constitution. In February 1913, the 16th Amendment removed the requirement that an income tax be levied in proportion to state population. The Underwood Tariff Act of 1913 included an income tax section.

Since 1913, the income tax laws have changed many times, and income tax rates have increased greatly. For example, withholding of employee income taxes began in 1943. Simplified returns and standard deductions came into use in 1944. In 1948, new provisions allowed exemptions for blindness and old age, and split-income joint returns for married couples. The Tax Reform Act of 1969 was a major revision of the income tax laws. It eliminated some situations in which corporations and individuals could legally avoid paying income taxes.

The Tax Reform Act of 1986 sharply reduced the number and level of tax rates. It also greatly increased the tax base by restricting deductions, credits, and exclusions. The act established two basic rates of 15 and 28 percent for the individual income tax. These rates replaced 14 rates ranging from 11 to 50 percent. The act also increased the size of personal exemptions for individuals, spouses, and dependents.

In the 1990's, changes in tax laws introduced many new deductions, credits, and exclusions; and the tax rates increased. In 1990, Congress established a third individual income tax rate of 31 percent, which applied to people with the largest incomes. In 1993, Congress added individual income tax rates of 36 and 39.6 percent. It also raised the rate for some corporations. The Taxpayer Relief Act of 1997 added new credits for dependent children and college tuition.

In 2001, Congress significantly reduced individual income tax rates. It also added a sixth individual rate of 10 percent and increased several deductions and credits.

Joel Slemrod

Related articles in *World Book* include:

Canada, Government of (Money and taxation)
Capital gains tax
Flat tax
Friedman, Milton
Income
Inland revenue
Internal revenue
Internal Revenue Service
Social security (Financing Social Security)
Tax Court, United States
Taxation

Additional resources

J. K. Lasser's Your Income Tax. Macmillan, published annually. An aid to filing returns.

Stanley, Robert. *Dimensions of Law in the Service of Order: Origins of the Federal Income Tax, 1861-1913.* Oxford, 1993.

Incompetence is a legal term most often applied to people who are mentally disabled due to retardation or mental or physical illness. These people are sometimes called *non compos mentis,* a Latin phrase meaning *not of sound mind.* An incompetent person does not have the legal capacity to make contracts or to control or dispose of property. There are legal procedures for declaring a person incompetent and appointing a guardian to take custody of the person and provide support. People under the legal age of adulthood are also considered incompetent to make contracts, except in some instances for such *necessaries* as food, shelter, and clothing. The legal age is 18 in most states. A person so drunk or drugged as to be incapable of understanding a contract is treated as incompetent regarding the contract.

Evidence is called *incompetent* when it is not proper to be received in a trial. Judges and juries are said to be *incompetent* if they have an interest in the trial and its outcome. A judge may be disqualified from a trial on this basis. Aidan R. Gough

See also **Contract; Guardian; Minor; Ward.**

Incontinence is the involuntary loss of urine or *feces* (solid waste matter) from the body. An incontinent person lacks control of the bladder or bowels. Incontinence may result from nerve and muscle changes due to aging or from various other causes. It can cause social embarrassment, loss of self-esteem, and withdrawal from daily activities.

Urinary incontinence is often caused by loss of muscle support to the bladder and *urethra* (urinary canal). In women, this loss may stem from childbirth, which weakens the pelvic muscles. Actions that involve contractions of the abdominal muscles—such as coughing, sneezing, lifting, or standing up—put pressure on the bladder and urethra, resulting in leakage of urine. Urinary incontinence also may be caused by weakening of the *urethral sphincter*—the ring of muscles in the urethra that controls the flow of urine. A weakened or damaged sphincter may fail to close completely, causing urine loss.

In men, urinary incontinence often occurs when enlargement of the prostate gland obstructs the flow of urine. The bladder fails to empty completely, overfills, then leaks. In addition, surgery for treatment of prostate disorders may damage the urethral sphincter or pelvic muscles and cause incontinence.

Fecal incontinence is most common in elderly people. It may be related to bowel problems, mental decline, or disorders, such as stroke and multiple sclerosis, that damage nerves.

Many people with incontinence wear special waterproof undergarments that help prevent leakage of urine or feces. Exercises called Kegel exercises can strengthen the pelvic muscles and reduce or prevent urinary incontinence. Various medications can improve function of the sphincter or the bladder muscle. In some types of urinary incontinence, surgery can improve or cure symptoms. Fecal incontinence is treated with diet, medication, or surgery. Roger R. Dmochowski

See also **Bladder; Diarrhea.**

Incorporation. See **Corporation.**

Incubation is the process in which fertilized eggs and young organisms are kept under proper conditions for growth and development. Female birds usually incubate their eggs by sitting on them. But machines called *incubators* may also be used for the incubation of birds' eggs, newly hatched chicks, and even human beings. Incubators maintain the proper temperature and proper humidity favorable to good development. See also **Incubator; Animal** (Incubation). George B. Johnson

Incubator is an apparatus that maintains a favorable environment for growth and development. Hatcheries use incubators to hatch chicks from eggs. Other types of incubators are used in hospitals to maintain the lives of newborn or prematurely born babies. Some incubators are used in laboratories for various research projects. All incubators differ in design, but their chief function—to provide a controlled environment—is the same.

Incubators for eggs vary in size from small homemade boxes to huge commercial cabinets that can hold thousands of eggs. A typical commercial incubator is divided into a *setter section,* where the eggs are kept for most of the incubation period, and a *hatcher section,* where the eggs are placed two to three days before hatching. The incubator is heated to maintain a constant temperature of about 99.5 °F (37.5 °C). Ventilation is adjusted to remove carbon dioxide and to bring in fresh air. Moisture is added to the air to maintain a relative humidity of 60 to 65 percent. Mechanical devices in the incubator turn the eggs several times daily.

Incubators for babies look like enclosed cribs. They have transparent covers so that the baby can be seen at all times. The temperature is controlled by a thermostat or a temperature-sensing device attached to the baby's skin. The incubator temperature is adjusted to maintain the baby's body temperature at 97.7 to 99.5 °F (36.5 to 37.5 °C). Additional oxygen may also be supplied if necessary. Premature babies are kept in incubators until they can live in a normal environment. Melvin L. Hamre

See also **Animal** (Incubation); **Chicken** (Hatcheries).

Indentured servant was someone who worked without wages for a period of time in exchange for passage to the American Colonies. The term most commonly refers to Europeans who signed a contract to work a term of years, usually four, in return for payment of their voyage, food, clothing, and shelter. The contract was called an *indenture.* Most indentured servants were young men between the ages of 15 and 25 looking for jobs and a better life. Some debtors and convicts were also sent to the colonies as indentured servants.

The system of indenturing servants started during the 1600's to provide cheap labor for the colonies. Over half of all immigrants to the colonies after the 1630's came as indentured servants. By the early 1700's, black slaves had become the main labor source for the Southern Colonies and the two Chesapeake Colonies of Virginia and Maryland. There were indentured servants until the early 1800's. But by then, they were no longer a major part of the U.S. labor force. Pauline Maier

See also **African Americans** (Colonial times); **Colonial life in America** (Indentured servants).

Independence (pop. 113,288) is a historic city in western Missouri, just east of Kansas City. For location, see **Missouri** (political map). Independence became known in the 1800's as the starting point of the Oregon and Santa Fe trails, key routes in the westward expansion of the United States. The first mail stagecoaches to the Far West also started in Independence. Confederate and Union forces clashed there during the American Civil War (1861-1865). In the mid-1900's, Independence became famous as the home of President Harry S. Truman.

Independence is the world headquarters of the Community of Christ (formerly called the Reorganized Church of Jesus Christ of Latter Day Saints). The church's temple and auditorium are local landmarks. The Harry S. Truman Library in Independence attracts many visitors. It includes a library and a museum, with personal papers and mementos of the president. Truman is buried on the grounds. The National Frontier Trails Center has exhibits on the California, Oregon, and Santa Fe trails. Many old mansions in the city have been restored as historic sites or private homes. The city's industries include the production of small-caliber ammunition, farm machinery, and instant tea.

The first permanent settlers arrived in what is now Independence in 1825. Independence became an incorporated city in 1849. It is the seat of Jackson County and has a council-manager government. Dale Brendel

Independence, Declaration of. See **Declaration of Independence.**

Independence, War for. See **Revolutionary War in America.**

Independence Day is the birthday of a nation, marking the anniversary of its freedom from the rule of another country. Many countries large and small celebrate their Independence Day.

The best-known Independence Day is that of the

United States, celebrated every July 4. It is the anniversary of the day on which the Second Continental Congress adopted the Declaration of Independence, July 4, 1776. The Congress declared the American Colonies free and independent states.

In early days, American Independence Days were occasions for shows, games, military music, and fireworks. Today, most cities and states forbid the sale of fireworks, though many have large public fireworks displays organized by professionals. Celebrations often include parades, games, concerts, speeches, and picnics.

The Philippines achieved full independence from United States rule on July 4, 1946. But the Philippines' Independence Day is on June 12, commemorating the declaration of independence from Spain made in 1898.

The territory once ruled by the United Kingdom as India gave rise to five separate nations. India became independent on Aug. 15, 1947, the day after Pakistan gained full self-government. In 1948, Burma (now Myanmar) became fully independent on Jan. 4, and Ceylon (now Sri Lanka) won its independence on Feb. 4. Bangladesh, previously the eastern part of Pakistan, declared its independence on March 26, 1971.

A notable year for first Independence Days was 1960, when 18 countries gained full self-government. British Somaliland and Italian Somaliland became the nation of Somalia when the two territories gained independence from the United Kingdom and Italy. Cyprus and Nigeria also became independent of the United Kingdom that year. Fifteen African countries also gained independence from French or Belgian rule in 1960. These nations were Benin, Burkina Faso, Cameroon, the Central African Republic, Chad, Congo, Côte d'Ivoire, Gabon, Madagascar, Mali, Mauritania, Niger, Senegal, Togo, and Zaire (now Congo [Kinshasa]). Carole S. Angell

Independence Hall, or Old State House, is the most famous building in Philadelphia, and the scene of some of the most important events in American history. Patriots met in the Hall in May 1775, in the Second Continental Congress. There they chose George Washington as commander in chief of the Continental Army.

On July 4, 1776, John Hancock signed the Declaration of Independence in the Hall. On July 8, the Liberty Bell in the Hall's tower proclaimed the first public reading of the Declaration. The bell, displayed in the Hall for many years, now hangs in a building just north of the Hall. Congress Hall and other historic buildings are also nearby. Theodore Hershberg

See also **Liberty Bell; Pennsylvania** (picture).

Independent counsel is a specially appointed official who investigates or prosecutes another individual when the regular prosecutor may be biased or have a conflict of interest in the case. Independent counsels are also called *special counsels, special prosecutors,* and *independent prosecutors.*

In the United States, the U.S. attorney general may appoint an independent counsel to prosecute high-level officials of the federal government's executive branch and their associates. Such cases normally would be prosecuted by the attorney general. However, an independent counsel may be asked, for example, to investigate charges against the president so that the attorney general does not have to do so. In this kind of a case, the attorney general might be biased in favor of the president, who appointed him or her. After investigating the charges, the independent counsel may refer them to the House of Representatives for impeachment hearings.

A special federal Office of Independent Counsel existed from 1978 to 1999. The law that created the office required the attorney general to request the appointment of an independent counsel in certain cases. In those cases, the attorney general referred the charges against the accused official to a special panel of federal judges. The panel then appointed the independent counsel. But some people objected to the high cost, great length, and broad scope of the investigations of independent counsels appointed under the law. Others complained that political parties used the office to attack elected officials from other parties. For information on cases in which independent counsels have been used, see **Clinton, Bill; Iran-contra affair;** and **Watergate.**

Laws of many U.S. states provide for special prosecutors at the local level when a relative or close associate of a district attorney is accused of a crime. Similar procedures exist in many other countries. In England and Wales, for example, the director of public prosecutions may replace a prosecutor with one from another geographical area in certain cases. Jack M. Kress

Index is an alphabetical list of topics and subjects that appears at the end of many books. It refers to all the important ideas or names mentioned in a book and lists the pages where they can be found. The *table of contents* lists chapter headings and appears at the beginning of a book.

The most common kind of index lists—in alphabetical order—the topics and the page or pages on which they appear:

Adam, 195
Diamond, 502
Emerald, 409
Gem, 111, 213, 409

An *analytical index* groups many individual subtopics under major subject headings. For example, the following list shows that the book contains information on gems in general and on specific gems, such as diamonds and emeralds:

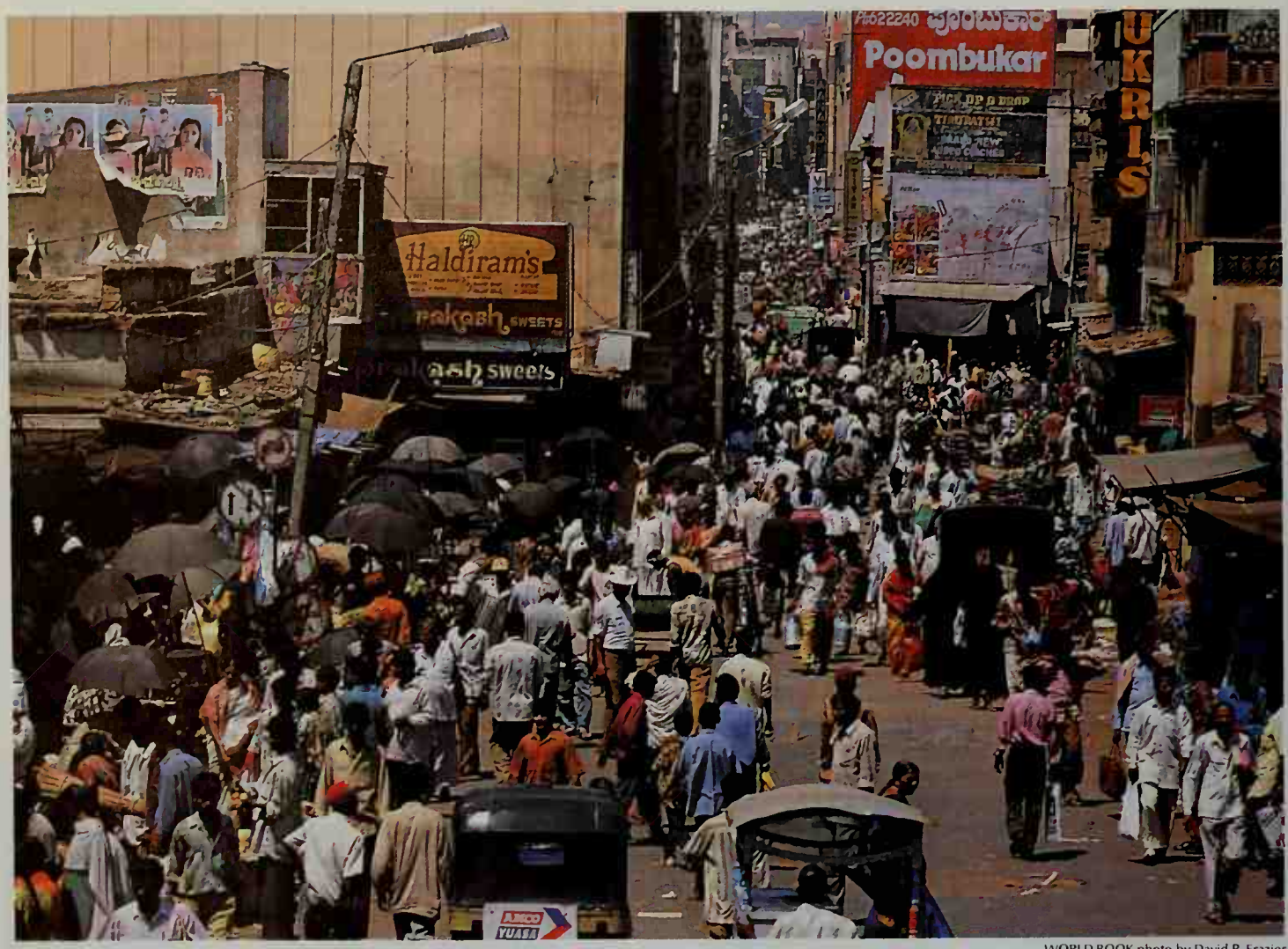
Adam, 195
Gem, 111, 213, 409
  Diamond, 502
  Emerald, 409

Many indexes, such as those to magazines or newspapers, fill large volumes. They list articles by author, title, and subject. Some libraries have *card indexes,* or *card catalogs,* that list all their books, either on paper cards or an electronic database. Many encyclopedias have indexes large enough to fill whole volumes. Sara Garnes

Index of Forbidden Books, commonly called the Index, was a list of books the Roman Catholic Church once forbade its members to read without special permission. The church considered the books harmful to faith or morals. The church abolished the Index in 1966 and no longer publishes lists of forbidden book titles.

Pope Paul IV drew up the church's first official list of prohibited books in 1559. He forbade Catholics to read any titles he named. Before being abolished, the Index was revised more than 40 times. John Patrick Donnelly

Indexation. See **Cost of living; Inflation** (Effects on income).



WORLD BOOK photo by David R. Frazier

India is one of the largest and most densely populated countries in the world. The country has many crowded cities, such as Bangalore, shown here. However, most of India's people live in rural areas.

India

India is a country in southern Asia that ranks as the second largest country in the world in population. Only China has more people. India is also one of the most densely populated countries in the world and one of the largest in area. Its capital is New Delhi. Mumbai, formerly called Bombay, is its largest city.

Much of India forms a peninsula that extends southward into the Indian Ocean. India is bordered on the west by the Arabian Sea and Pakistan; on the north by China, Nepal, and Bhutan; and on the east by Myanmar, Bangladesh, and the Bay of Bengal. India, Bangladesh, Bhutan, Nepal, and Pakistan are sometimes said to make up a region called the Indian subcontinent.

India is a land of great variety and contrast. The mighty snow-capped Himalaya, the world's tallest mountain system, rises along its northern border. A vast, scorching desert lies in the west, but parts of eastern India receive some of the highest rainfall in the world. The country also has broad plains, winding rivers, lush rain forests, and tropical lowlands.

The people of India belong to a variety of ethnic groups and speak hundreds of dialects and languages. Hindi is the national language and is widely spoken in north and central India.

The people of India practice a number of religions. A large majority are Hindus, but India has one of the largest populations of Muslims in the world as well.

Indians vary widely in terms of education and wealth. India has a growing number of scientists and engineers, but a large part of the population cannot read and write. India is one of the world's major manufacturing countries, but many of its people live in extreme poverty.

Most Indians are farmers, and they depend on seasonal rains to grow their crops. These farmers live in villages throughout the land. However, a growing number of Indians work in offices and factories in the country's cities. The urban centers of Delhi, Kolkata, and Mumbai are among the largest in the world.

India has been home to several major empires and civilizations through the ages. The first of these civiliza-

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WORLD BOOK photo by David R. Frazier

tions, the Indus Valley civilization, was established about 4,500 years ago. Through the centuries, travelers to India described it as a land rich in gold, spices, textiles, and other valuables, and India became fabled for its wealth. Eventually, it attracted European traders, and in the late 1700's, India came under British rule. In 1947, after a long struggle for freedom, India became independent.

Government

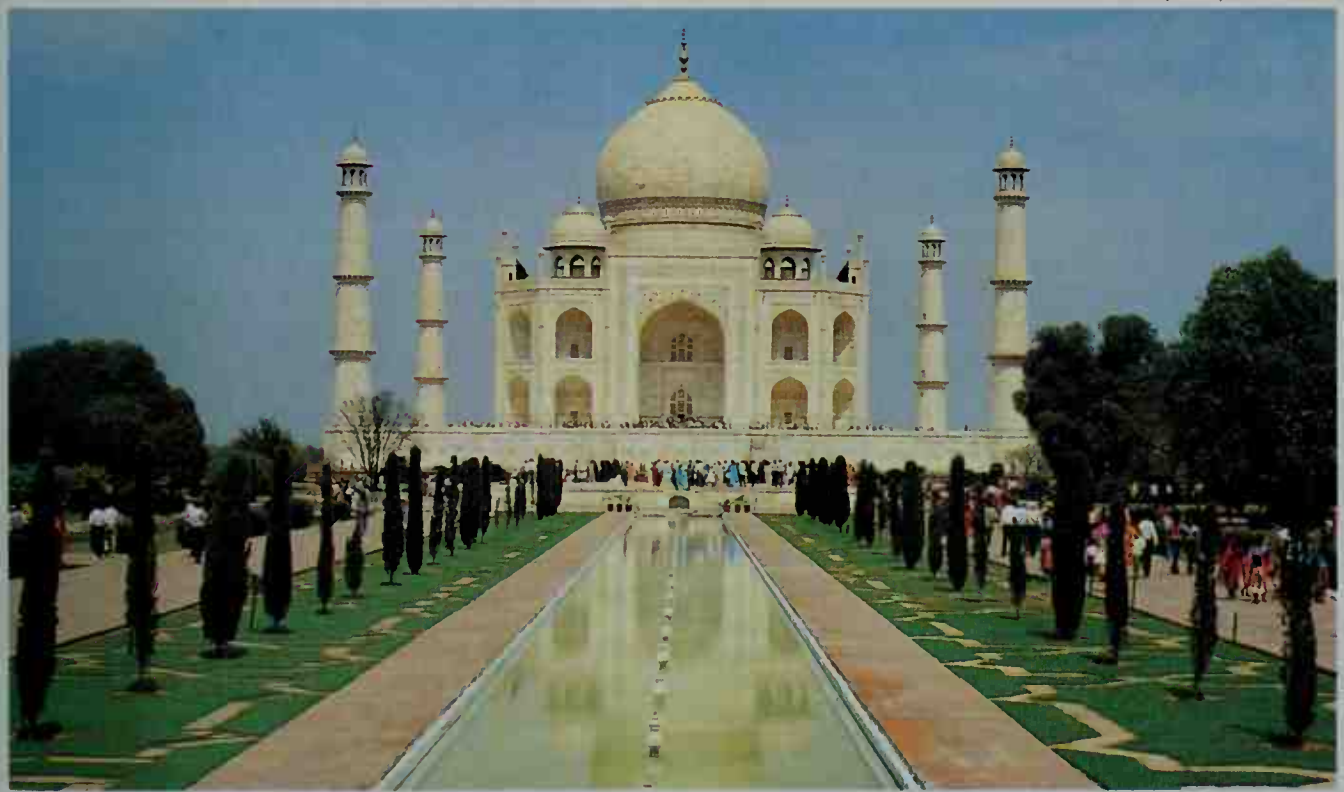
India is a republic made up of 28 states and 7 union territories. Its Constitution went into effect on Jan. 26, 1950. The Constitution guarantees equal rights to all citizens, and it prohibits discrimination on the basis of race, sex, *caste* (social class), religion, or place of birth. The Constitution also includes guidelines called *directive principles of state policy.* These principles call for the government to promote the welfare of the people. For example, they urge the government to establish a minimum wage, provide education and jobs for people from disadvantaged backgrounds, and improve public health.

Central government. India has a parliamentary system of government. The president of India is the head of state, and the prime minister is the head of the government. Parliament is the chief lawmaking body of India. It consists of the president and two houses—the Lok Sabha (House of the People) and the Rajya Sabha (Council of States).

The president of India is elected to a five-year term by an electoral college consisting of the elected members of Parliament and the state and territorial legislatures.

The art treasures of India rank among the greatest in the world. The Taj Mahal at Agra, *below,* is India's most famous building. The beautiful white marble tomb was built in the Islamic style about 1650. Colorful statues of Hindu divinities, *left,* decorate a temple at Bangalore. Most Indians are Hindus.

WORLD BOOK photo by David R. Frazier



India in brief

Capital: New Delhi.
Principal official language: Hindi. *Other languages with official status:* English ("associate national language"), Sanskrit, and 16 regional languages.
Official name: Bharat Ganarajya (Republic of India).
National anthem: "Jana-gana-mana" ("Thou Art the Ruler of the Minds of All People"). *National song:* "Vande Mataram" ("I Bow to Thee, Mother").
Largest cities: (2001 census)

Mumbai (11,914,398)
Delhi (9,817,439)
Kolkata (4,580,544)
Bangalore (4,292,223)
Chennai (4,216,268)

India's flag was adopted in 1947. It has horizontal stripes of orange-yellow, white, and green. The wheel is an ancient symbol called the *Dharma Chakra* (Wheel of Law).

India's national emblem is copied from a pillar built by Ashoka, an ancient Indian emperor. The words in Sanskrit beneath the pillar mean "Truth alone triumphs."

Land and climate

Land: India lies in southern Asia, north of the Indian Ocean. It borders Pakistan, China, Nepal, Bhutan, Myanmar, and Bangladesh. Most of northern India is a low-lying plain that includes the valleys of the Ganges and Brahmaputra rivers. The Himalaya rises in the far northern parts of the country. The large triangular peninsula that forms southern India is a plateau bordered on the east and west by mountains that drop down to coastal plains.

Area: 1,269,346 mi² (3,287,590 km²). *Greatest distances*—north-south, about 2,000 mi (3,200 km); east-west, about 1,700 mi (2,740 km). *Coastline*—4,252 mi (6,843 km), including 815 mi (1,312 km) of coastline of island territories.
Elevation: *Highest*—Kanchenjunga, 28,208 ft (8,598 m) above sea level. *Lowest*—sea level along the coast.

Climate: Northern and central India have mild, cool temperatures from October to February. In the northwest and north-central regions, temperatures occasionally drop below freezing. Southern India lacks a true cool season, but the period from October to February is not as hot as the rest of the year. The entire country, except the mountains, is hot from March to June. From June to September, rains brought by seasonal winds called *monsoons* bring relief from extreme dry heat. The northeast and west coasts receive heavy rainfall.

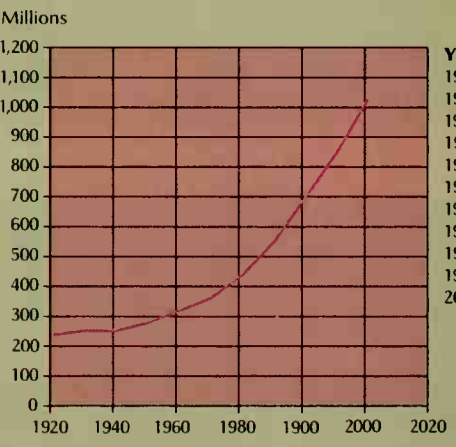
Government

Form of government: Federal republic.
Head of state: President.
Head of government: Prime minister.
Legislature: Parliament of two houses—Lok Sabha (545 members) and Rajya Sabha (a maximum of 250 members). The Lok Sabha is more powerful than the Rajya Sabha.
Executive: President and prime minister. The prime minister selects the members of the Council of Ministers, who are then appointed by the president.
Judiciary: Highest court is the Supreme Court.
Political subdivisions: 28 states and 7 territories.

People

Population: *Estimated 2002 population*—1,042,449,000. *2001 census*—1,027,015,247.
Population density: 821 per mi² (317 per km²).
Distribution: 72 percent rural, 28 percent urban.
Major ethnic groups: 72 percent Indo-Aryan, 25 percent Dravidian.
Major religions: 82 percent Hindu, 12 percent Muslim, 2 percent Christian, 2 percent Sikh.

Population trend



Year	Population
1901	238,396,000
1911	252,093,000
1921	251,321,000
1931	278,977,000
1941	318,661,000
1951	361,088,000
1961	439,235,000
1971	548,160,000
1981	696,833,000
1991	846,303,000
2001	1,027,015,247

Economy

Chief products: *Agriculture*—bananas, beans, chickpeas, coconuts, cotton, jute, mangoes, onions, oranges, peanuts, pepper, potatoes, rice, sesame seeds, sorghum, sugar cane, tea, wheat. *Manufacturing and processing*—bicycles, brassware and silverware, cement, chemicals, clothing and textiles, fertilizer, food products, iron and steel, jute bags and rope, leather goods, machinery, medicines, motor vehicles, paper, petroleum products, rugs, sewing machines, sugar, wood products. *Mining*—coal, iron ore, limestone, petroleum.
Money: *Basic unit*—rupee. One hundred paise equal one rupee.
International trade: *Major exports*—chemicals, cotton textiles and clothing, cut diamonds and jewelry, engineering goods, handicrafts, iron ore, leather goods, tea. *Major imports*—chemicals, fertilizer, industrial machinery, pearls and gemstones, petroleum products. *Major trading partners*—Germany, Japan, Saudi Arabia, United Kingdom, United States.

WORLD BOOK photo by David R. Frazier

New Delhi is the capital of India. Both houses of the Indian Parliament meet in the circular Parliament House, which appears in the foreground. The British built the structure in the early 1900's, during their rule of India. Government office buildings stand behind Parliament House.

Bills approved by Parliament must receive the president's signature before they can become law.

The prime minister, who is appointed by the president, is the most powerful person in the Indian government. The prime minister is usually the leader of the party that has the largest number of seats in Parliament. The prime minister heads the Council of Ministers. Council members are appointed by the president on the prime minister's recommendation. They assist in running the day-to-day operations of the government. A prime minister who loses the support of a majority in the Lok Sabha can be dismissed by the president. The president can then dissolve the Lok Sabha and call a new election.

The most important of the two houses of the Indian Parliament is the Lok Sabha. States and territories with larger populations send more representatives to the Lok Sabha than do those with smaller populations. Voters elect 543 of the 545 members of the Lok Sabha. The president names the other 2. Members serve a five-year term unless the president calls for elections earlier.

The Rajya Sabha has a maximum of 250 members, who serve six-year terms. The state and territorial legislatures elect all but 12 of the members. The president may nominate up to 12 remaining members, who are well-known academic or cultural figures.

State governments. Most Indian states have one legislative body, but some have two. Most members are elected by the people. Each state has a governor and a chief minister. The governor is appointed by the president of India. The chief minister is appointed by the governor and is typically the leader of the party with the most seats in the legislature.

The states traditionally have had little power in relation to the central government. For example, Parliament has the right to establish or abolish states and to change state boundaries and names. Parliament also taxes the largest sources of revenue, such as business and personal income. The states have very limited and poorer sources of income, including real estate taxes and licensing fees. As a result, most states rely largely on assistance from the central government for their income.

Courts. The Supreme Court is India's highest court. Its justices are appointed by the president. The Supreme Court hears cases that involve disputes between states or between a state and the central government. It also acts as the final court of appeal in certain criminal and civil cases. In addition, the Supreme Court serves as the final interpreter of the Constitution and can declare legislation passed by Parliament to be unconstitutional.

India has 18 high courts, which serve the individual states and territories. The high courts hear original cases as well as appeals from lower courts.

Politics. India has many political parties. The Congress Party, or one of the branches that developed from it, dominated Indian politics for nearly all the years from 1947 to the 1980's. Since then, the party's strength has declined. Other national parties include the Bharatiya Janata Party (BJP-Indian People's Party), the Janata Dal (People's Party), and the Communist Party (Marxist).

Regional parties play an important role in Indian politics. In some parts of the country, political parties representing certain language, religious, or ethnic groups have successfully formed governments. All Indians who are at least 18 years old can vote.

Armed forces. India has an army, navy, and air force. More than a million people serve in the armed forces. Military service is voluntary.

People

Ancestry. India's people belong to a variety of ethnic groups. The two largest groups are the Dravidians and the Indo-Aryans. Most Dravidians live in the south. Most Indo-Aryans live in the north.

The Dravidians are descended from some of the earliest inhabitants of India. About 2500 B.C., these early people are believed to have established an advanced civilization that spread through the Indus Valley in what are now Pakistan and western India. The Indo-Aryans trace their ancestry to a central Asian people called the Aryans. Around 1500 B.C., the Aryans invaded India. They gradually conquered the Dravidians and drove some of them south.

From about the A.D. 400's to the late 1400's, central Asian peoples settled in northern India. Many of their descendants live in the area now occupied by the states of Jammu and Kashmir, Uttaranchal, Uttar Pradesh, and Bihar. Some groups in the far north and northeast are closely related to peoples of East and Southeast Asia.

India
political map
International boundary
State or territorial boundary
Road
Railroad
National capital
State or territorial capital
Other city or town
WORLD BOOK map
1
2
3
4
5
6
7
A
B
C
D
E
F
G
H
I
J
70
80 East Longitude
90
30
20
10 North Latitude
Tropic of Cancer
The ownership of Jammu and Kashmir is disputed between India and Pakistan. The boundary shown follows the Shimla Agreement of 1972.
AFGHANISTAN
PAKISTAN
CHINA
NEPAL
INDIA
SRI LANKA
MALDIVES
Arabian Sea
Bay of
Indian Ocean
Gulf of Kutch
Gulf of Khambhat
Gulf of Mannar
Laccadive Islands
Amindivi Is
Minicoy I
Kavaratti
Lakshadweep
Jammu and Kashmir
Himachal Pradesh
Punjab
Chandigarh
Haryana
Delhi
Uttaranchal
Uttar Pradesh
Rajasthan
Gujarat
Madhya Pradesh
Bihar
Sikkim
Jharkhand
West Bengal
Chhattisgarh
Orissa
Maharashtra
Daman
Diu
Dadra and Nagar Haveli
Goa
Karnataka
Andhra Pradesh
Yanam
Kerala
Mahe
Tamil Nadu
Pondicherry
Karaikal
Gilgit
Khyber Pass
Peshawar
Islamabad
Rawalpindi
Sialkot
Gujranwala
Sargodha
Lahore
Faisalabad
Sahiwal
Multan
Bahawalpur
Shikarpur
Sukkur
Mirpur Khas
Hyderabad
Karachi
Hotan
Shiquanhe
Siling Lake
Lhaze
Xigaze
Kathmandu
CORBETT NATIONAL PARK
Srinagar
Leh
Jammu
Pathankot
Dharmsala
Amritsar
Jalandhar
Hoshiarpur
Shimla
Firozpur
Ludhiana
Chandigarh
Ambala
Dehra Dun
Haridwar
Bathinda
Patiala
Ganganagar
Karnal
Saharanpur
Sirsa
Panipat
Muzaffarnagar
Haldwani
Hisar
Delhi
Meerut
Moradabad
Rohtak
New Delhi
Faridabad
Ghaziabad
Rampur
Pilibhit
Bareilly
Budaun
Lakhimpur
Aligarh
Shahjahanpur
Bahraich
Mathura
Farrukhabad
Sitapur
Agra
Firozabad
Lucknow
Gorakhpur
Bettiah
Faizabad
Ayodhya
Etawah
Kanpur
Gwalior
Sultanpur
Fatehpur
Jaunpur
Allahabad
Varanasi
Mirzapur
Jhansi
Shivpuri
Bikaner
Churu
Sikar
Alwar
Pokaran
Jaisalmer
Jaipur
Jodhpur
Beawar
Ajmer
Tonk
Barmer
Pali
Bundi
Bhilwara
Kota
Udaipur
Mandsaur
Dungarpur
Patan
Mahesana
Bhuj
Gandhinagar
Ahmadabad
Ratlam
Ujjain
Godhra
Dewas
Nadiad
Indore
Jamnagar
Khambhat
Vadodara
Mhow
Rajkot
Porbandar
Bhavnagar
Junagadh
Bharuch
Surat
Navsari
Veraval
Daman
Silvassa
Nasik
Dhule
Jalgaon
Bhusawal
Malegaon
Aurangabad
Jalna
Kalyan
Thane
Mumbai
Ulhasnagar
Ahmadnagar
Parbhani
Nanded
Alibag
Pune
Barsi
Latur
Osmanabad
Satara
Solapur
Bidar
Gulbarga
Ratnagiri
Sangli
Bijapur
Kolhapur
Ichalkaranji
Belgaum
Panaji
Dharwad
Gadag
Hubli
Hospet
Bellary
Karwar
Davangere
Chitradurga
Shimoga
Bhadravati
Chikmagalur
Tumkur
Hassan
Mangalore
Bangalore
Mandya
Mysore
Tellicherry
Kozhikode
Tiruppur
Erode
Palghat
Coimbatore
Trichur
Dindigul
Ernakulam
Cochin
Kottayam
Alleppey
Quilon
Tirunelveli
Trivandrum
Nagercoil
Cape Comorin
Sagar
Damoh
Murwara
Panna
Satna
Maihar
Rewa
Bhopal
Jabalpur
Shahdol
Chhindwara
Seoni
Khandwa
Burhanpur
Amravati
Nagpur
Akola
Wardha
Yavatmal
Chandrapur
Bhandara
Gondia
Durg
Raipur
Bhilai
Dhamtari
Bilaspur
Raigarh
Ambikapur
Jagdalpur
Jeypore
Nizamabad
Warangal
Sangareddi
Secunderabad
Hyderabad
Kottagudem
Khammam
Mahbubnagar
Raichur
Vijayawada
Guntur
Tenali
Eluru
Rajahmundry
Kakinada
Machilipatnam
Kurnool
Adoni
Ongole
Proddatur
Anantapur
Cuddapah
Nellore
Gudur
Tirupati
Kolar
Chittoor
Chennai
Vellore
Kanchipuram
Dharmapuri
Salem
Pondicherry
Cuddalore
Kumbakonam
Thanjavur
Nagappattinam
Tiruchchirappalli
Madurai
Aruppukkottai
Rajapalaiyam
Tuticorin
Palayankottai
Jaffna
Trincomalea
Kandy
Muzaffarpur
Darbhanga
Chhapra
Patna
Purnia
Ara
Bihar Sharif
Munger
Bhagalpur
Katihar
Dehri
Gaya
Darjiling
Siliguri
Gangtok
Jalpaiguri
Ingraj Bazar
Baharampur
Hazaribagh
Dhanbad
Bokaro
Asansol
Durgapur
Purulia
Ranchi
Barddhaman
Bhatpara
Jamshedpur
Haora
Kolkata
Raurkela
Kharagpur
Baleshwar
Sambalpur
Balangir
Dhenkanal
Cuttack
Bhubaneshwar
Bhawanipatna
Puri
Brahmapur
Chhatrapur
Chilka Lake
Srikakulam
Vizianagaram
Vishakhapatnam
Indus
Jhelum
Chenab
Ravi
Sutlej
Ganges
Yamuna
Chambal
Gandak
Ghaghra
Sapt Kosi
Son
Narmada
Mahanadi
Hooghly
Godavari
Bhima
Krishna
Penner
Cauvery
North
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000

India map index

States

Map key	Name	Population	Area In mi²	Area In km²	Capital
H 4	Andhra Pradesh	75,727,541	106,205	275,069	Hyderabad
C 9	Arunachal Pradesh	1,091,117	32,333	83,743	Itanagar
D 9	Assam	26,638,407	30,285	78,438	Dispur
D 6	Bihar	82,878,796	36,357	94,163	Patna
E 5	Chhattisgarh	20,795,956	52,198	135,191	Raipur
H 3	Goa	1,343,998	1,429	3,702	Panaji
E 2	Gujarat	50,596,992	75,685	196,024	Gandhinagar
C 4	Haryana	21,082,989	17,070	44,212	Chandigarh
B 4	Himachal Pradesh	6,077,248	21,495	55,673	Shimla
A 4	Jammu and Kashmir	10,069,917	39,146	101,387	Srinagar
E 6	Jharkhand	26,909,428	30,778	79,714	Ranchi
H 3	Karnataka	52,733,958	74,051	191,791	Bangalore
I 3	Kerala	31,838,619	15,005	38,863	Trivandrum
E 4	Madhya Pradesh	60,385,118	119,014	308,245	Bhopal
F 3	Maharashtra	96,752,247	118,756	307,577	Mumbai
D 9	Manipur	2,388,634	8,621	22,327	Imphal
D 8	Meghalaya	2,306,069	8,660	22,429	Shillong
E 9	Mizoram	891,058	8,142	21,087	Aizawl
D 9	Nagaland	1,988,636	6,401	16,579	Kohima
F 6	Orissa	36,706,920	60,119	155,707	Bhubaneshwar
B 3	Punjab	24,289,296	19,445	50,362	Chandigarh
D 3	Rajasthan	56,473,122	132,139	342,239	Jaipur
C 7	Sikkim	540,493	2,740	7,096	Gangtok
I 4	Tamil Nadu	62,110,839	50,216	130,058	Chennai
E 8	Tripura	3,191,168	4,049	10,486	Agartala
D 5	Uttar Pradesh	166,052,859	93,023	240,928	Lucknow
B 5	Uttaranchal	8,479,562	21,236	55,000	Dehra Dun
E 7	West Bengal	80,221,171	34,267	88,752	Kolkata

Territories

H 9	Andaman and Nicobar Islands	356,265	3,185	8,248	Port Blair
J 9	Andaman Islands				
	Nicobar Islands				
B 4	Chandigarh	900,914	44	114	Chandigarh
F 2	Dadra and Nagar Haveli	220,451	190	491	Silvassa
	Daman and Diu	158,059	43	112	Daman
F 3	Daman District				
F 2	Diu District				
C 4	Delhi	13,782,976	573	1,483	Delhi
	Lakshadweep	60,595	12	32	Kavaratti
I 2	Amindivi Islands				
J 2	Minicoy Island				
I 2	Laccadive Islands				
	Pondicherry	973,829	185	480	Pondicherry
I 4	Karaikal District				
I 3	Mahe District				
I 4	Pondicherry District				
G 5	Yanam District				

Cities and towns

Agartala	189,327	E	8
Agra	1,259,979	D	4
Ahmadabad	3,515,361		
	†4,519,278	E	2
Ahmadnagar	307,455	F	3
Aizawl	229,714	E	9
Ajmer	485,197	D	3
Akola	399,798	F	4
Aligarh	667,732	C	4
Allahabad	990,298	D	5
Alleppey	177,079	J	3
Alwar	260,245	C	4
Amravati	549,370	F	4
Amritsar	975,695	B	3
Asansol	486,304	E	7
Aurangabad	872,667	F	3
Ayodhya	49,593	D	5
Bally*	261,575	E	7
Bangalore	4,292,223		
	†5,686,844	H	4
Bareilly	285,871	E	7
Belgaum	699,839	C	5
Bellary	399,600	G	3
Bhagalpur	317,000	H	4
Bhatpara	340,349	D	7
Bhavnagar	441,956	E	7
Bhilai	510,958	E	2
Bhiwandi*	553,837	F	5
Bhopal	598,703	F	2
Bhubaneshwar	1,433,875	E	4
Bihar Sharif	647,302	F	6
Bijapur	231,972	D	6
Bikaner	245,946	G	3
Bilaspur	529,007	C	3
Bokaro	265,178	E	5
Bombay, see Mumbai	394,173	E	6
Brahmapur	289,724	F	6
Burhanpur	194,360	E	4
Calcutta, see Kolkata			
Chandigarh	808,798	B	4
Chennai	4,216,268		
	†6,424,624	H	5
Cochin	596,473	I	3
Coimbatore	923,085	I	4
Cuttack	535,139	F	6
Darbhanga	266,834	D	6
Darjiling	107,530	D	7
Davangere	363,780	H	3
Dehra Dun	447,808	B	4
Delhi	9,817,439		
	†12,791,458	C	4
Dhanbad	198,963	E	7
Dhule	341,473	F	3
Dindigul	196,619	I	4
Dispur	‡1,725	D	8
Durgapur	492,996	E	7
Eluru	189,772	G	5
Erode	151,184	I	4
Faridabad	1,054,981	C	4
Farrukhabad	227,876	C	5
Firozabad	278,801	D	4
Gandhinagar	195,891	E	3
Gangtok	29,162	C	7
Gauhati	808,021	D	8
Gaya	383,197	D	6
Ghaziabad	968,521	C	4
Gorakhpur	624,570	D	6
Gulbarga	427,929	G	4
Guntur	514,707	G	5
Gwalior	826,919	D	4
Haora	1,008,704	E	7
Hubli	786,018	H	3
Hyderabad	3,449,878		
	†5,533,640	G	4
Imphal	217,275	D	9
Indore	1,597,441	E	3
Itanagar	34,970	C	9
Jabalpur	951,469	E	5
Jaipur	2,324,319	D	4
Jalandhar	701,223	B	3
Jalgaon	368,579	F	3
Jamnagar	447,734	E	2
Jamshedpur	570,349	E	7
Jhansi	383,248	D	4
Jodhpur	846,408	D	3
Kakinada	289,920	G	5
Kalyan	1193,266	F	3
Kanchipuram	152,984	I	4
Kanpur	2,532,138		
	†2,690,486	D	5
Kavaratti	10,113	I	2
Kharagpur	207,984	F	7
Kohima	78,584	D	9
Kolhapur	485,183	G	3
Kolkata	4,580,544		
	†13,216,546	E	7
Kota	695,899	D	3
Kottayam	60,725	J	3
Kozhikode	436,527	J	3
Kumbakonam	140,021	I	4
Kurnool	267,739	G	4
Lucknow	2,207,340	D	5
Ludhiana	1,395,053	B	4
Machilipatam	183,370	G	5
Madras, see Chennai			
Madurai	922,913	I	4
Malegaon	409,190	F	3
Mangalore	398,745	H	3
Mathura	298,827	C	4
Meerut	1,074,229	C	4
Moradabad	641,240	C	4
Mumbai	11,914,398		
	†16,368,546	F	2
Muzaffarnagar	316,452	C	4
Muzaffarpur	305,465	D	6
Mysore	742,261	I	3
Nadiad	192,799	E	3
Nagercoil	208,149	J	4
Nagpur	2,051,320	F	4
Nanded	430,598	F	4
Nasik	1,076,967	F	3
Nellore	378,947	H	5
New Delhi	294,783	C	4
Nizamabad	286,956	F	4
Panaji	58,785	G	3
Panihati*	348,379	E	7
Patiala	302,870	C	4
Patna	1,376,950	D	6
Pondicherry	220,749	I	4
Port Blair	100,186	I	9
Pune	2,540,069		
	†3,755,525	F	3
Quilon	361,441	J	3
Raipur	605,131	F	5
Rajahmundry	313,347	G	5
Rajkot	966,642	E	2
Rampur	281,549	C	4
Ranchi	846,454	E	6
Ratlam	221,267	E	3
Raurkela	224,601	E	6
Rohtak	286,773	C	4
Sagar	232,321	E	4
Saharanpur	452,925	C	4
Salem	693,236	I	4
Sangli	436,639	G	3
Shahjahanpur	297,932	C	5
Shillong	132,876	D	8
Shimla	142,161	B	4
Shimoga	274,105	H	3
Siliguri	470,275	D	7
Silvassa	21,890	F	3
Solapur	873,037	G	3
South Dum Dum*	392,150	E	7
Srinagar	894,940	A	3
Surat	2,433,787		
	†2,811,466	F	3
Thane	1,261,517	F	2
Thanjavur	215,725	I	4
Tiruchchirappalli	746,062	I	4
Tirunelveli	411,298	J	4
Tiruppur	346,551	I	4
Trivandrum	744,739	J	3
Tuticorin	§199,854	J	4
Udaipur	389,317	D	3
Ujjain	429,933	E	3
Ulhasnagar	472,943	F	3
Vadodara	1,306,035	E	3
Varanasi	1,100,748	D	6
Vellore	177,413	I	4
Vijayawada	825,436	G	5
Vishakhapatnam	969,608	G	6
Warangal	528,570	G	4

*Does not appear on map; key shows general location
†Population of metropolitan area, including suburbs.
‡1981 census.
§1991 census.
Source: 2001 census, except where indicated by ‡ or §.

A number of smaller groups of peoples live in remote forests and hills throughout India. Often referred to as tribes or tribal groups, these peoples include the Bhils, Gonds, Khasis, Mizos, Mundas, Oraons, and Santals.

Languages. People in India speak over 1,000 languages and dialects—more than in any other part of the world. Most Indian languages belong to two main language groups: Indo-Aryan, which is a branch of the Indo-European family of languages, and Dravidian.

Modern Indo-Aryan languages are based on an ancient language called Sanskrit. About three-fourths of the Indian population, mainly in north and central India, speak one or more of the main Indo-Aryan languages. These languages include Assamese, Bengali, Gujarati, Hindi, Kashmiri, Marathi, Oriya, Punjabi, and Sindhi.

The four principal languages of southern India—Kannada, Malayalam, Tamil, and Telugu—belong to the Dravidian family of languages. About a fifth of the population speaks these languages.

In the Himalayan region of the northeast and along the border with Myanmar many people speak Kuki, Manipuri, Naga, and other Sino-Tibetan languages. Some groups in the northeast and certain central areas use Mundari and Santali, which belong to the Mon-Khmer, or Austro-Asiatic, family of languages.

India's national language is Hindi, one of the Indo-Aryan languages. More than two-fifths of the people speak one or more of the dialects of this language, and at least some Hindi is understood by as many as two-thirds of the population. The study of Hindi is required in elementary and secondary schools in India.

English has an official status as an associate national language. It is the common language among educated people across India, and much of the nation's official business is conducted in English. In cities especially, many parents try to send their children to English-language elementary and secondary schools. English is widely used at colleges and universities.

Through the years, the Indian government has at times sought to introduce Hindi in non-Hindi speaking areas. Immediately after independence, the Indian government argued that national unity would be best promoted by encouraging the spread of Hindi, the most widely spoken Indian language. But non-Hindi speakers feared that they would face discrimination in their search for jobs. They also wanted recognition for their own languages. They urged that Indian states be reorganized according to language groups. After much pressure on the Indian government, the first of such states, Andhra (now Andhra Pradesh), was established for Telugu speakers in 1953.

Today, the boundaries of India's states are based largely on language. But each state still includes people from multiple language and dialect groups. Several states have large numbers of Hindi speakers. Each state also has its own official language. For example, Bengal's official language is Bengali and Tamil Nadu's is Tamil.

Way of life

India is such a large and varied country that there is no one way of life practiced by all—or even most—Indians. Food and clothing vary throughout the country. People follow a number of religious beliefs and practices. Social structure differs from place to place. Nevertheless, there are some features of Indian life that are common among most people throughout the country.

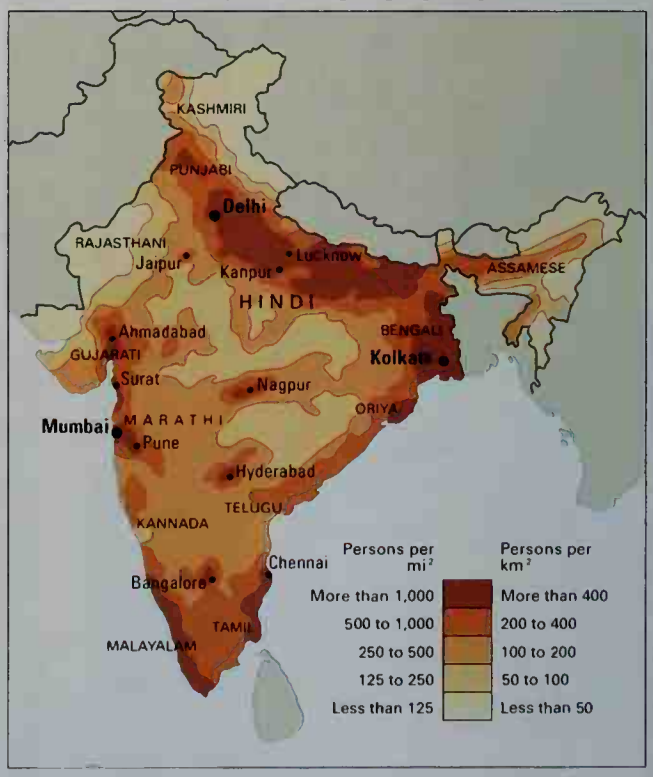
Family life. Family ties are important to most Indians. The number of *nuclear families*—that is, households that consist of only parents and their children—is increasing, especially in cities. However, many families continue to live as traditional *extended families*. In a typical Indian extended family, three generations live together in one household. Upon marriage, a woman leaves her parents' home and shares a household with her husband and his relatives, including his brothers and their wives, his unmarried sisters, and his parents.

Parents usually arrange marriages, though a couple may reject an arrangement made by the parents. Marriages for love do occur, but many people think of marriage more as an alliance between families than as a relationship between two people. The bride's family typically pays a dowry to the husband's family. The dowry may be money, goods, or both. Today, the paying of a dowry is illegal, but the practice continues nonetheless.

Indians generally expect a young married couple to have a child within a few years after marriage. In India, as in most other rural societies, sons are preferred over daughters. In rural areas, sons are expected to work on the land and take care of their parents.

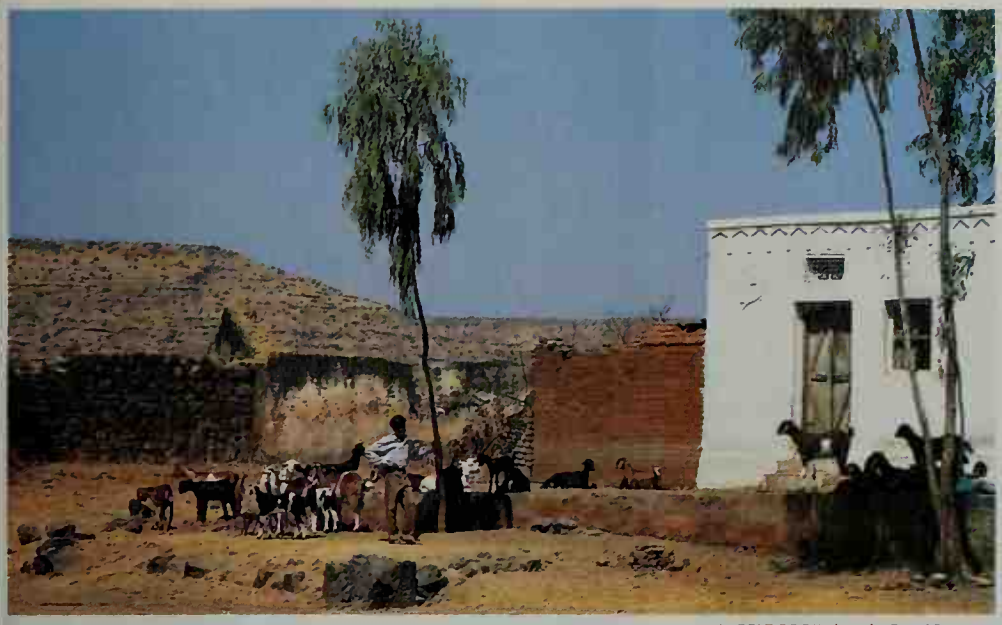
Village life. Most of India's people live in villages. Most villagers are farmers who work in nearby fields. A typical Indian village is a collection of mud-and-straw dwellings. These homes are generally small, consisting of one or two rooms with mud floors. Wealthier families live in brick or concrete houses.

Population density and language groups



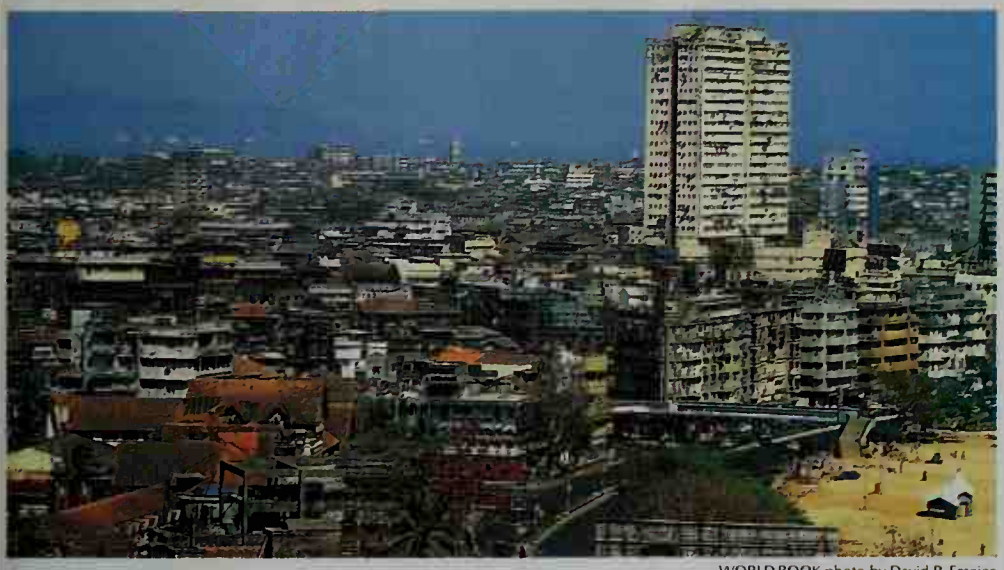
WORLD BOOK map

India ranks second in population—after China—among the world's countries. This map shows where the people of India live and the location of the largest cities, as well as where the major languages are spoken.



WORLD BOOK photo by David R. Frazier

Village life in India has changed little through the years. Most Indians live in such rural communities. They raise livestock and grow crops in nearby fields. This village is located on the plains of the Deccan Plateau near the city of Aurangabad.



WORLD BOOK photo by David R. Frazier

Mumbai, formerly called Bombay, is the largest city in India. Modern high-rise apartment and office buildings stand in parts of the city, but most of Mumbai's people live in crowded slums.

Most villagers own few possessions. These belongings typically include brass pots for cooking and clay pots for carrying water and storing grain. Village people cook foods on a *chula*, a clay oven that burns coal. People sit and sleep on cots of woven string, which are dragged outside on warm days. Many people also sleep outside. If the village is without electric power, kerosene lanterns are used for light. A local well or nearby pond or river provides water for most villages. Some larger villages have running water.

A council of elected elders, called a *panchayat,* governs most villages. The panchayat has the power to hear complaints and administer punishments.

City life. Varanasi (also called Banaras or Benares), Patna (formerly called Pataliputra), and some other Indian cities were commercial, political, and religious centers in ancient times. They attracted pilgrims, traders, and people seeking their political fortunes. After arriving in India in the 1600's, the British developed the fishing villages of Bombay (now Mumbai), Calcutta (now Kolkata), and Madras (now Chennai) into major ports. These cities are now among the largest in India.

Older Indian cities have a densely populated center. Many of these cities once had walls surrounding them for protection against enemies. After the city expanded outside its walls, the section inside became known as the *walled city.* Buildings occupy most of the space in city centers, which bustle with activity. People, animals, automobiles, and smaller vehicles, such as rickshaws, hand-pulled carts, and bicycles, compete for space on the narrow, twisting streets. Various traders sell their wares in shops with fronts open to the street. Entire families live in, above, and behind the shops.

During the British rule of India, the Britons who lived in Indian cities made their homes in areas called *cantonments.* The cantonments had pleasant bungalows and wide, treelined streets, and lay far from the crowded sections where the Indians lived. Today, politicians, military officers, wealthy business people, and other leaders live in the cantonments. These areas now include modern buildings and shopping districts.

Most Indian cities have a growing middle class, which includes government employees, office workers, and shopkeepers. A large number of urban dwellers work at

manual labor or in factory jobs. Many vendors, such as vegetable and fruit sellers, cobblers, and plumbers, peddle their goods and services on the street.

The population of Indian cities has increased tremendously since independence. Millions of people have moved from rural to urban areas in search of jobs. This rapid population growth has strained city resources. For example, the supply of water and electric power has not kept up with the needs of the increasing population. Despite efforts to build low-cost and improved housing, many people—including some members of the middle class—still lack adequate homes. As a result, they must live in slums or on the streets. In the slums, as many as 10 people may be crammed into a one-room shack, and toilet facilities may be shared by the entire slum.

Social structure. Indians, especially Hindus, have traditionally been organized into social groups called *castes.* A person's caste determines his or her social status within the community and influences what occupations a person might hold.

Ancient Hindu texts described four groups called *varnas.* The Brahmans (priests and scholars) were the highest group, followed by Kshatriyas (rulers and warriors), Vaishyas (merchants and professionals), and Shudras (artisans, laborers, and servants). Over time, each varna came to include smaller castes called *jatis.* Altogether, the caste system has thousands of categories.

Complicated rules govern contact and behavior between the castes. For example, marriages between people of widely different castes are rare, and the upper castes do not eat with the Shudras. In principle, when members of a caste eat cooked food, it should be prepared only by someone of the same caste or a higher caste. For example, Brahmans would eat only food cooked by other Brahmans. Many members of the upper castes do not eat meat, fish, or eggs.

Today, caste barriers are weaker than they have been, especially in cities. There the various castes mix with one another every day. They work side by side in factories and offices, ride in buses and trains together, and mingle on the streets. In the cities, too, rules against castes dining with one another have greatly relaxed.

A large group of people—approximately 15 percent of the population—is considered to be outside the caste system. Known as *untouchables, harijans* (children of God), *dalits* (downtrodden), or the *scheduled castes,* this group has an even lower status than the Shudras. Untouchables have traditionally held the most undesirable jobs, such as the cleaning of toilets and the disposal of garbage. Some upper-caste people believe that they will be polluted by the touch of members of this group.

Under the Indian Constitution, the untouchables are supposed to have equal rights. Discrimination in jobs and education against the untouchables is forbidden by law. The government has also set aside for them and other disadvantaged groups a significant percentage of government jobs, scholarships, and legislative seats. Nevertheless, the untouchables remain an oppressed group, especially in villages. There, for example, they are often denied entry to Hindu temples and forbidden to draw water from certain village wells. They also may be excluded from participation in village political life.

Religion plays a vital role in the lives of most Indians. India has no official religion, and people of various faiths practice their religion freely. Over 80 percent of the people are Hindus. About 12 percent are Muslims. Smaller percentages of Indians practice other religions. They include Buddhists, Christians, Jains, and Sikhs.

WORLD BOOK photo by David R. Frazier

A street market in Bangalore offers fruits and vegetables to shoppers. Many Indians in the cities work as food vendors or craftworkers, selling their goods and services on the street.

Hinduism. The religious beliefs and practices of Hindus vary enormously. Hindus have many sacred texts, including the Vedas, the Upanishads, and the Puranas. These writings serve as a guide to moral conduct.

Hindus believe in *reincarnation*—that is, that the body alone dies, and the soul, which does not die, is reborn in another body. This process can be repeated for thousands of years. Liberated beings are those whose souls, having achieved spiritual perfection, enter a higher state of existence. Hinduism also teaches such virtues as *ahimsa* (nonviolence), *yoga* (a spiritual discipline that involves fitness of body and mind), and the unimportance of material goods. Hindus consider cows to be sacred and therefore do not believe in eating beef.

Hindus believe there is a single spiritual force—God, also called Brahman—that takes many forms. These forms make up the many gods and goddesses of Hindu belief. People worship whichever form—that is, whichever god or goddess—pleases them the most. Most Hindus worship Shiva or Vishnu. Vishnu's two most popular *incarnations* (human forms) are Krishna and Rama. Popularity of the individual gods and goddesses varies from place to place. In Bengal, for example, worship of the goddess Kali is common, but in Maharashtra, people worship Ganesh, an elephant-headed god.

There are a number of Hindu religious festivals. They include Holi, which marks the arrival of spring, and a festival popularly called Diwali, which is celebrated in the fall. During Holi, people sprinkle colored water and

powders on one another. Fireworks light up the night during Diwali, which honors several Hindu deities.

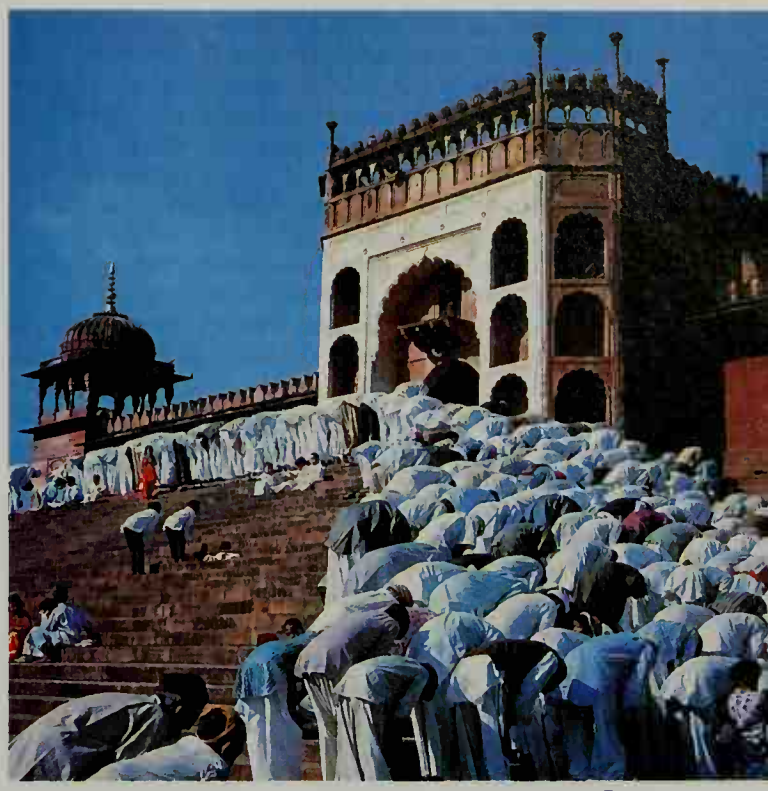
Islam. India has one of the largest Muslim populations in the world. Most Indian Muslims live in the north, but there are also major Islamic centers, such as Hyderabad, in the south. Many live in urban areas.

Islam came to India in the 700's, but most Muslims in India are descendants of Hindus who converted to the new faith. There have been outbreaks of violence between Muslims and Hindus through the years. But they have also lived together peacefully. Over time, they have developed a common culture in some areas.

Buddhism was founded in India about 500 B.C. by Siddhartha Gautama. It flourished in ancient India. It later spread to other countries but declined in India. Buddhists today are mainly converts from the lower castes.

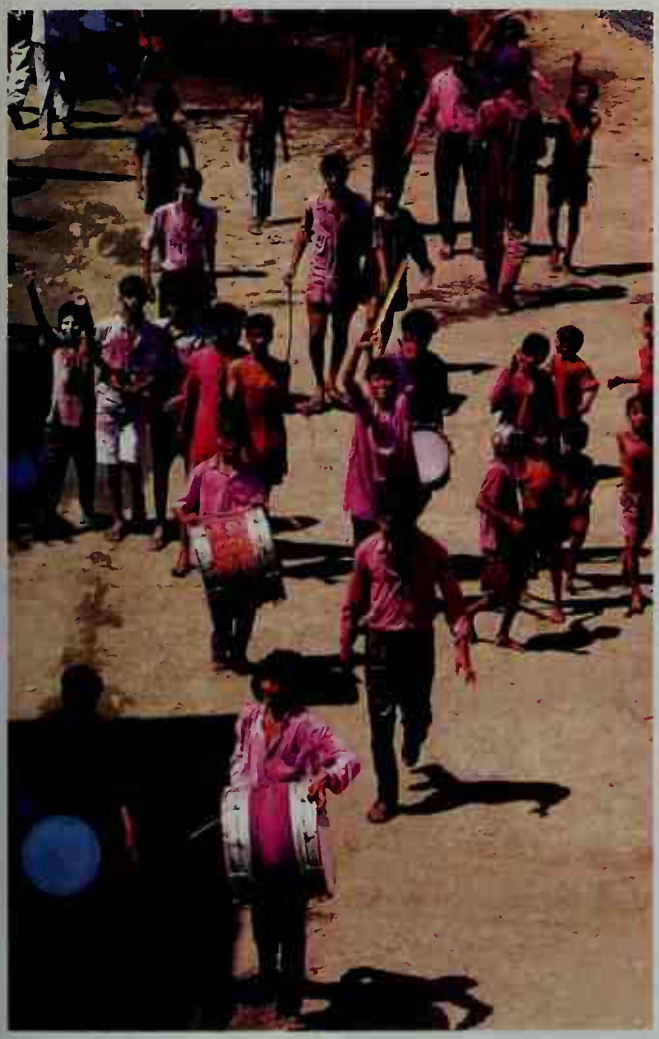
Christianity existed in several small communities when Europeans came to India about 1500. But it spread mainly after the Europeans arrived. Indian Christians live largely in the southern states of Kerala and Tamil Nadu, and in the tribal regions of northeast India.

Jainism was founded in India in the 500's B.C. by a religious reformer named Mahavira. Jains believe all life is sacred, and most are strict vegetarians. They have been especially successful in business and the professions.



Taurus

Muslims, followers of Islam, make up India's largest religious minority. The people pictured here are praying at one of the country's many beautiful *mosques* (Islamic houses of worship).



WORLD BOOK photo by David R. Frazier

A Hindu religious festival called Holi celebrates the arrival of the spring season. Celebrants sprinkle colored water and powder on one another and parade through the streets.

Sikhism is a religion founded in India by Nanak, a *guru* (religious teacher) who lived in the late 1400's and early 1500's. Sikhs pride themselves on their bravery and do not believe in caste. As a mark of equality, many Sikh men use the same last name, Singh, which means *lion.* Most Sikhs are farmers and traders. They also make up a large part of the Indian army.

Other religions. India also has the largest population of Zoroastrians in the world. Usually called Parsis in India, the Zoroastrians fled Persia (now Iran) over 1,000 years ago when it was being converted to Islam. They have become business leaders. India has had a Jewish community since about the A.D. 100's, though many Indian Jews moved to Israel during the 1950's and 1960's. Many Indians also practice folk religions.

Clothing worn by Indians varies greatly by region. Members of the various religious or ethnic groups also may dress differently. But most Indians wear light, loose clothing because of the hot climate.

Most Indian women wear a *sari.* This garment consists of a straight piece of cloth about 5 yards (6 meters) long that is draped around the body as a long dress. Its loose end is flung over a shoulder or used to cover the head. A sari is usually worn with a blouse. Unmarried women and young girls, especially in northern India, commonly wear long flowing trousers called a *shalwar* and a long blouse called a *kameez.* Tribal women wear long skirts. Many Christian women in the south wear Western-style skirts and blouses. Some young women in cities, especially wealthier women, wear jeans.

Many men wear a *dhoti.* This simple garment, which is usually white, is wrapped between the legs to form a kind of loose trousers. It can also be wrapped around

the lower half of the body like a skirt and is then knotted at the waist. A shirt is worn over the upper half of the body. Poor laborers and farmers may wear only a *loincloth,* which is a piece of cloth wrapped around the hips and between the thighs. On formal occasions, some men wear a long, tight coat over loose trousers called a *pajama* that are wide at the top and sharply taper toward the bottom. In the cities, Western-style shirts and trousers, and increasingly, jeans, are popular.

Food and drink. Rice, wheat, and other grains rank among the chief foods of India. *Pulses,* which are the seeds of such pod vegetables as beans, chickpeas, and lentils, are also widely consumed.

Indian cooking is extremely varied, and foods eaten in one part of the country may be completely unknown elsewhere. For example, a typical north Indian meal consists of *chapattis, dal,* and a vegetable dish. Chapattis are thin, flat breads. Dal is a porridge made with specially prepared lentils. A typical meal in West Bengal would probably also include fish, and rice would substitute for the chapattis. In the south, a typical meal would consist of rice, *sambar* (a lentil preparation that resembles dal), and vegetables. Yogurt, pickles, and such fresh fruits as apples, bananas, guavas, and mangoes are part of most meals throughout the country.

Most Indian meals are cooked in *ghee* (liquid butter) or vegetable oil. A number of spices, such as coriander, cumin, garlic, ginger, mustard seeds, red pepper, and turmeric, flavor most dishes. Chicken and mutton are expensive and are eaten mainly on special occasions. Hindus do not believe in eating beef, and Muslims do not believe in eating pork. Many Indians are vegetarians.

The most popular beverage in India is tea, though many southern Indians prefer coffee. Western soft drinks are widely available, but fairly expensive.

Food production in India increased enormously in the late 1900's, and today the country exports wheat and rice. Even so, the nutritional needs of at least a third of the population are not being met, in part because many people cannot afford sufficient food. Many women, in particular, have trouble getting adequate nourishment. Especially in traditional homes, the men and children are served by the women and older girls, who eat what is left at the end of the meal.

WORLD BOOK photo by David R. Frazier

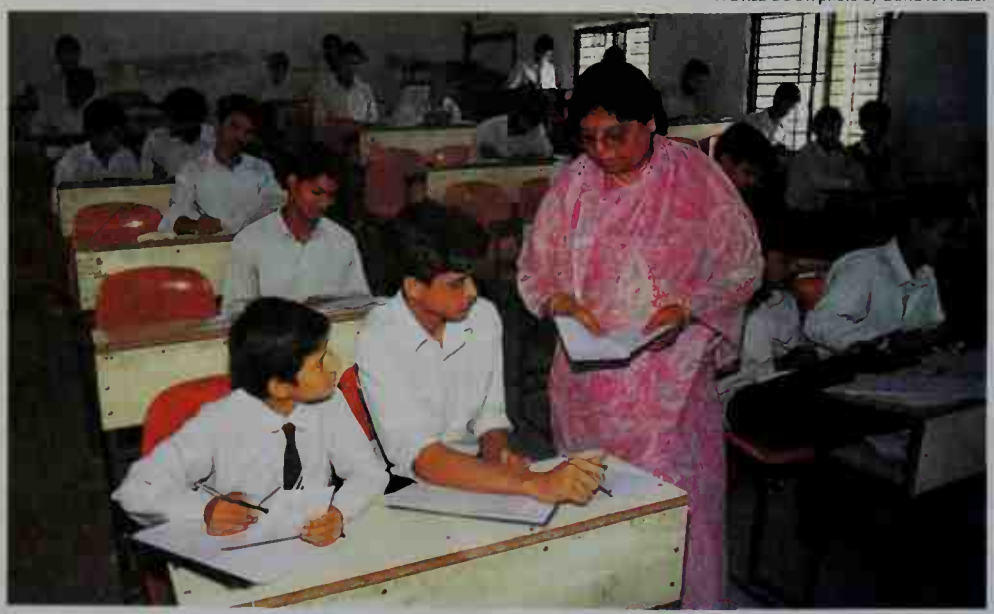
A family dinner in India may consist of a variety of dishes, depending on the region. Rice is India's chief food. In the north, meals usually include thin, flat breads called *chapattis.*

Health care. Life expectancy rates for both women and men are much lower in India than in the United States and Europe. Infant death rates are much higher. See **Life expectancy** (table).

Dismal living conditions account for many diseases. Standards of sanitation, hygiene, and nutrition are poor, especially in villages and urban slums. High levels of pollution in the cities have led to a sharp increase in illnesses of the lungs.

On the other hand, India has made great strides in controlling cholera, malaria, and other infectious diseases. Government clinics across the country provide cheap medical care to government employees and their families. Other public clinics and hospitals attend to the needy. In addition, the government runs family-planning clinics to help control the growing population. In urban

WORLD BOOK photo by David R. Frazier



Public education in India provides free schooling for children from age 6 through 14. This class is studying in a New Delhi public school. Despite the availability of education, many Indian children must leave school early for economic reasons. As a result, illiteracy remains a problem in the country.

areas, thousands of doctors have set up private practices, often at their own homes.

Recreation. The favorite sport in India is cricket. Field hockey and soccer are also popular. Indians enjoy playing cards and chess. Kite flying is also a common recreational activity. Many people spend their evenings watching television or going to motion-picture theaters. In large cities, people also attend concerts and plays.

Education. The Indian Constitution provides for free education for children from age 6 through 14. Nearly all Indian children receive some schooling, but only about half of those 10 years of age or older continue their education. There are several reasons why children drop out of school. Some children leave school because their parents put them to work on the family farm. Other children have to get jobs to help support their families or are needed at home to look after smaller children.

Because Indians receive little formal education, illiteracy is a major problem in India. Since about 1950, the government has spent much money on training teachers, publishing schoolbooks, and building schools. As a result, literacy rates have improved, and school attendance has increased substantially. However, about half of India's adult population still cannot read and write. For the country's literacy rate, see **Literacy** (table).

Universities are run by the central or state governments. India has over 8,000 universities and colleges. The University of Delhi has about 200,000 students.

The arts

The arts of India have a long history. They had reached high levels thousands of years ago. Indian arts also include a wide variety of forms and styles.

Architecture and sculpture. Sculpture flourished during the Indus Valley civilization, which was established about 2500 B.C. Buddhism was the next great influence on Indian architecture and sculpture. Several ruins of Buddhist monasteries and dome-shaped *stupas* (monuments) have survived from ancient times.

Caves were cut into a cliff of solid rock at Ajanta in western India between the 100's B.C. and the A.D. 600's. They feature spectacular examples of *frescoes* (wall-paintings on plaster) and sculpture. Artists worked at the nearby caves at Ellora until about A.D. 1000. The greatest monument at Ellora, dating from the late 700's, honors the Hindu god Shiva. It was carved out of the cliff like a great piece of sculpture. Magnificent sculptures of Hindu gods and goddesses were also carved in the caves at Elephanta, near Mumbai, mainly from the 600's to 900's.

Hindu temples are noted both for their architecture and for their exquisite sculptures. The temples have rows of sculptured columns, richly carved exteriors, and open porches. Temples in northern India have tall towers with curving sides that taper at the top. South Indian temples have gateway towers shaped like trapezoidal pyramids and made of steplike layers of stone. Each step has carvings that tell a story.

Muslims conquered parts of northern India during the 1200's and introduced their style of architecture. Muslim architecture in India reached its peak in the 1500's and 1600's. The outstanding Islamic building in India is the Taj Mahal (about 1650) in Agra. The Emperor Shah Jahan ordered the Taj Mahal built as a tomb for his favorite wife. The building features magnificent Islamic-style decoration, in which geometrical patterns and floral designs are inlaid in marble with semiprecious stones. Islamic art and architecture use such patterns and designs because Islam forbids the depiction of God or the human form.

The British and other Europeans added many buildings in Western styles to India after their arrival. During the 1700's, the British constructed churches and other buildings in the neoclassical style. Neoclassical architecture reflected a renewed interest in Europe in the architecture of ancient Greece and Rome. In the 1800's, the British designed many public buildings in India in the Gothic Revival style, with tall spires and pointed arches. Some British buildings include curved domes and other features of Islamic architecture.

Modern Indian architecture borrows from many styles. For example, the internationally recognized works of Charles Correa and Balkrishna Doshi mix traditional Indian forms with contemporary designs.

Painting. The frescoes in the caves at Ajanta are the most important early examples of Indian paintings. Wall-paintings that show scenes from Buddhist stories are commonly found in Buddhist temples and monasteries.

Miniature paintings on small pieces of paper developed into a distinct art form in India from 1500 to 1800. These paintings portrayed rulers, members of the nobility, scenes of hunting, or stories from Hindu legends.

In the 1800's, Indian painting was mainly an imitation of Western styles. Many artists of the 1900's, including

The Art Institute of Chicago, gift of Mr. and Mrs. Robert Andrew Brown

Sculpture ranks among India's greatest artistic achievements. An unknown sculptor carved this stone statue of the Hindu god Vishnu between the A.D. 900's and 1200's.

WORLD BOOK photo by David R. Frazier

Temples carved from rock at Ellora in western India rank among India's most important historical monuments. The temples represent the Buddhist, Hindu, and Jain religions.

© R. C. Everts, Photo Researchers

The tower of a temple in Madras rises in steplike stone blocks. The numerous sculptures that decorate each step tell stories about Hindu gods and goddesses.

Maqbool F. Husain and Amrita Sher-Gil, show both Indian and Western influences. Husain's paintings resemble those of the European *expressionists*, who attempted to give form to powerful emotions. Sher-Gil studied art in France but painted mostly Indian subjects. Nandlal Bose's works are based mainly on Indian folk forms.

Literature. All of India's major languages have written literatures, many of which are at least 1,000 years old. The earliest Indian written works—the Vedas—are about 3,000 years old. Composed in an early form of Sanskrit, these Hindu scriptures are poetical compositions that discuss God, the universe, and the nature of life.

India's two great epics, the *Mahabharata* and *Ramayana*, were also composed in Sanskrit. Parts of the *Mahabharata*, which includes the *Bhagavad-Gita*, are probably more than 2,500 years old. The *Ramayana* was likely begun about the same time. These poems have inspired Indian literature through the centuries. Today, they are generally read not in Sanskrit but in other Indian languages and English.

Many of the world's fables and folk tales come from India. The oldest collection of fables in India, the *Panchatantra*, may date from as early as the 200's B.C.

From about A.D. 500 to 1600, a social and religious movement called *bhakti* swept across India. Bhakti influenced the development of regional languages because it emphasized people's everyday speech. Many bhakti poets, including Jnaneshwar, Kabir, Mirabai, Surdas, and Tulsidas, are still among the most widely read authors in India. Their hymns are also set to music.

Later Indian literature continued to be written in all the major Indian languages and English. For example, Bankim Chandra Chatterji, sometimes called the father of the Indian novel, wrote in Bengali. His historical novels about Indian heroes helped spread Indian nationalism in the 1800's. Bengali-language writers of the early 1900's include Rabindranath Tagore, whose spiritual poetry won the Nobel Prize for literature in 1913, and Saratchandra Chatterji (also spelled Saratcandra Chattopadhyaya), whose novels emphasize social issues. Among the best-known Indian-born writers of the late 1900's are two who write in English—R. K. Narayan, whose novels depict Indian village life; and Salman Rushdie, whose writings combine fantasy, satire, and Hindu and Islamic lore.

Music and dance. The beginnings of Indian classical music date to ancient times. Styles, forms, and principles of composition developed over the centuries. Indian music sounds different from Western music partly because it uses different scales and musical instruments. The notes of the Indian scale are arranged in various patterns called *ragas*. Each raga has a special meaning and may be associated with a particular mood, emotion, season, or time of day. Indian instruments include the sitar, sarod, and vina, which are plucked stringed instruments; the tambura, which produces a *drone* (continuous tone); and the tabla and mridangam, which are drums.

Music for motion pictures, called *film music*, is extremely popular in India. Film music combines Indian classical, folk, and religious music with certain features

of Western music. Film music, for example, is typically played by a large orchestra that includes both Indian and Western instruments.

There are several major styles of classical Indian dance. They include the *bharata natyam* of southern India and the *kathak* of northern India. Both of these styles, like all classical Indian dances, draw upon the Hindu epics and other poems and stories about the lives of the Hindu deities. Both styles of dancing use highly stylized hand, foot, and arm gestures, and movements of the eyes and other facial features to indicate moods and tell stories.

Folk dancing is also popular and varies from region to region. For example, a favorite folk dance in the Punjab is the lively bhangra, in which male dancers jump high in the air. Like other folk dances, the bhangra has a freer form than classical dances.

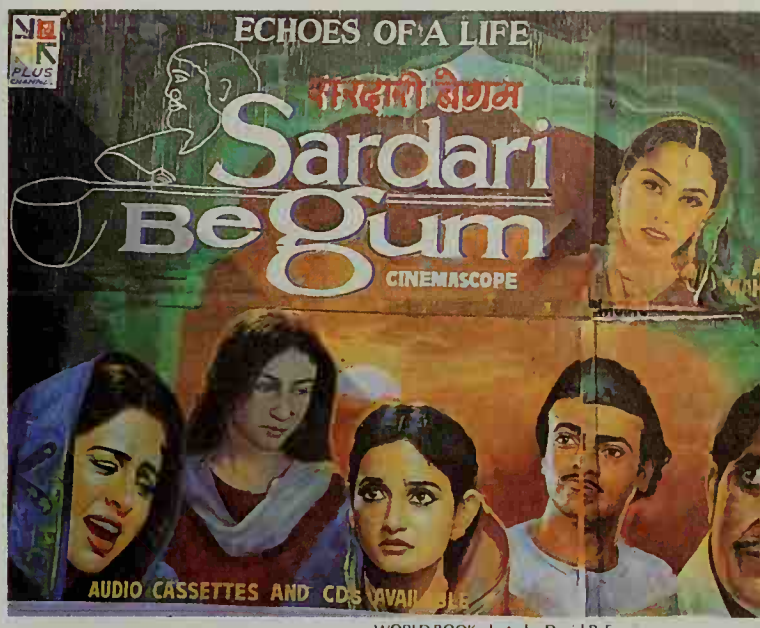
Motion pictures. India's motion-picture industry produces hundreds of films annually. The industry is centered in Mumbai. Indian movies are made in many languages, often for regional audiences. The most popular motion pictures are those made in Hindi, which are shown throughout the country. Hindi films also attract audiences in the Middle East, North and East Africa, the Caribbean, and in Indian communities overseas.

Indian popular films include love stories, crime thrillers, and social dramas. Like American musicals of the 1930's, all Indian popular films feature song-and-dance sequences.

The Indian motion-picture industry is also known for its art films. These motion pictures are more realistic than popular films. They explore such serious social themes as the problems of life in the city, the oppressiveness of the caste system, the difficulty of human relations, and the nature of guilt.

Looking for Krishna (ca. 1650) upaque watercolor on paper by unknown artist; The Art Institute of Chicago, Samuel M. Nickerson Fund, 1961.997 (© photo 2001 The Art Institute of Chicago. All rights reserved.

Indian painting is primarily religious art. This colorful miniature painting from about 1650 shows the Hindu god Krishna sitting with a young prince below and four milkmaids standing above.



WORLD BOOK photo by David R. Frazier

Motion pictures are popular throughout India. The Indian film industry produces hundreds of movies every year. Most are filmed in Hindi, but some are made in regional languages.

Several Indian directors have won international recognition for their work. Satyajit Ray won particular praise for his Apu Trilogy, a series of three motion pictures describing the growth of a boy to manhood in modern India. Other directors noted for making realistic films about Indian life include Shyam Benegal, Ritwik Ghatak, Adoor Gopalakrishnan, Mira Nair, and Mrinal Sen. Ismail Merchant, an Indian film producer, won world acclaim for his film adaptations of literary works.

The land

India covers 1,269,346 square miles (3,287,590 square kilometers) in South Asia. Tall mountains separate most of northern India from the rest of Asia. The southern half of the country is a triangular peninsula that juts into the Indian Ocean. The Arabian Sea laps India's shores to the west, and the Bay of Bengal lies to the east.

India has three main land regions. They are (1) the Himalaya, (2) the Northern Plains, and (3) the Deccan, also called the Southern Plateau.

The Himalaya, the highest mountain system in the world, extends for about 1,500 miles (2,400 kilometers) from northernmost India to the northeastern part of the country. The three almost parallel ranges of the Himalaya in India are nearly 200 miles (320 kilometers) wide at some places. The tallest mountain in India, Kanchenjunga, stands 28,208 feet (8,598 meters) high on the border of Nepal and India in the Himalaya. Dozens of other peaks in the system are more than 20,000 feet (6,100 meters) high. Snow covers the tall peaks throughout the year. The foothills of the Himalaya have many kinds of wildlife, including tigers, deer, and rhinoceroses, and many wildflowers.

The Northern Plains lie between the Himalaya and the southern peninsula. They stretch across northern India for about 1,500 miles (2,400 kilometers) and are from 150 to 200 miles (240 to 320 kilometers) wide. The plains include the valleys carved by the Brahmaputra, Indus, and Ganges rivers and their branches. This region is

the great heartland of India and forms the largest *alluvial plain* in the world. An alluvial plain is land formed of soil left by rivers. The soil in the Northern Plains is fertile, and farmers have tilled the land for centuries. The majority of Indians live in this region.

The Ganges, also known as the Ganga, is the greatest river in India. It originates high in the Himalaya and flows into the Bay of Bengal. Many important towns and cities, including Allahabad and Varanasi, lie along its banks. The Ganges is sacred to Hindus, and many Hindus bathe in the river to cleanse and purify themselves.

WORLD BOOK photo by David R. Frazier

Fertile cropland stretches across the Deccan Plateau in southern India. This plateau also has forests and mineral deposits. The Vindhya and other mountains separate it from the rest of India.

The Thar Desert (also called the Great Indian Desert or the Indian Desert) lies in the western part of the Northern Plains. It covers much of the state of Rajasthan and parts of Gujarat. Few people live in this area.

The Deccan Plateau forms most of the southern peninsula. It is separated from the Northern Plains by a mass of mountain and hill ranges, most prominently the Satpura, Vindhya, and Aravalli. On the eastern edge of the Deccan, a rugged mountain range called the Eastern Ghats rises to an average height of 2,000 feet (610 meters) before slanting down gradually to a wide plain. The Western Ghats form the western boundary of the Deccan. This range reaches a height of about 8,000 feet (2,440 meters) before falling sharply to a narrow coastal plain. The southernmost point of the plateau is formed by the Nilgiri Hills, where the Eastern and Western Ghats meet.

Major rivers of the Deccan Plateau include the Cauvery (also spelled Kaveri), Godavari, Krishna, and Mahandi. Most of the Deccan is farmland. Parts of the Eastern and Western Ghats are heavily forested and are home to elephants, monkeys, and other wildlife.

Climate

Most of India has three main seasons. They are (1) the cool season, (2) the hot season, and (3) the rainy season.

The cool season lasts from October to February. During the cool season, the foothills of the Himalaya receive much snow, though the highest peaks are snow-covered the year around. During the cool season, the temperature in the Himalaya region drops well below the freezing point of 32 °F (0 °C). The northwestern and north-central parts of the Northern Plains have a wide range of

© Gurmeet Thukral, Black Star

The majestic Himalaya is the world's highest mountain system. It consists of several mountain ranges that rise in steps from the plains of northern India along India's borders with China and Nepal. *Himalaya* means *House of Snow* or *Snowy Range* in Sanskrit, an ancient language of India.

Physical features

Amindivi Islands ..... F 2
Anai Mudi (mountain) ..... G 2
Andaman Islands ..... F 7
Andaman Sea ..... F 7
Arabian Sea ..... E 1
Aravalli Range ..... C 2
Banas River ..... C 2
Bay of Bengal ..... F 5
Betwa River ..... C 3
Bhakra Dam ..... B 3
Bhima River ..... E 2
Brahmani River ..... D 5
Brahmaputra River ..... C 6
Cape Comorin ..... G 3
Cauvery River ..... F 3
Chambal River ..... C 3
Chenab River ..... A 2
Chilka Lake ..... D 5
Chindwin River ..... C 7
Chota Nagpur Plateau ..... C 5
Coromandel Coast ..... F 4
Damodar River ..... D 5
Deccan Plateau ..... E 3
Eastern Ghats (mountains) ..... E 4
Gandak River ..... C 4
Ganges River ..... B 3
Ghaghra River ..... C 4
Gir Hills ..... D 1
Godavari River ..... E 4
Great Channel ..... G 7
Gulf of Khambhat ..... D 2
Gulf of Kutch ..... D 1
Gulf of Mannar ..... G 3
Himalaya (mountains) ..... A 3
Hooghly River ..... D 5
Indian Ocean ..... G 5
Indravati River ..... E 4
Indus River ..... A 2
Jhelum River ..... A 2
Jog Falls ..... F 2
Kalsubai (mountain) ..... D 2
Kanchenjunga (mountain) ..... C 2
Karakoram Pass ..... A 3
Karakoram Range ..... A 3
Kathiawar Peninsula ..... D 1
Khasi Hills ..... C 6
Krishna River ..... E 3
Laccadive Islands ..... F 2
Ladakh Range ..... A 3
Lushai Hills ..... C 6
Mahanadi River ..... D 5
Mahendra Giri (mountain) ..... E 5
Malabar Coast ..... F 2
Minicoy Island ..... G 2
Mt. Everest ..... B 5
Mouths of the Ganges ..... D 6
Naga Hills ..... C 7
Nanda Devi (mountain) ..... B 4
Narmada River ..... D 3
Nicobar Islands ..... G 7
Nilgiri Hills ..... F 3
Nine Degree Channel ..... G 1
Northern Plains ..... C 4
Palar River ..... F 3
Palk Strait ..... G 3
Penganga River ..... D 3
Penner River ..... F 3
Punjab Plains ..... B 2
Rann of Kutch (salt flat) ..... C 1
Ravi River ..... B 2
Sapt Kosi River ..... C 5
Sarda River ..... C 4
Satpura Range ..... D 3
Son River ..... C 4
Sutlej River ..... B 2
Tapi River ..... D 2
Ten Degree Channel ..... G 7
Thar Desert (Indian Desert) ..... C 2
Tungabhadra River ..... E 3
Vale of Kashmir ..... A 3
Vindhya Range ..... D 3
Wainganga River ..... D 3
Western Ghats (mountains) ..... E 2
Yamuna River ..... B 3
Zaskar Range ..... A 3

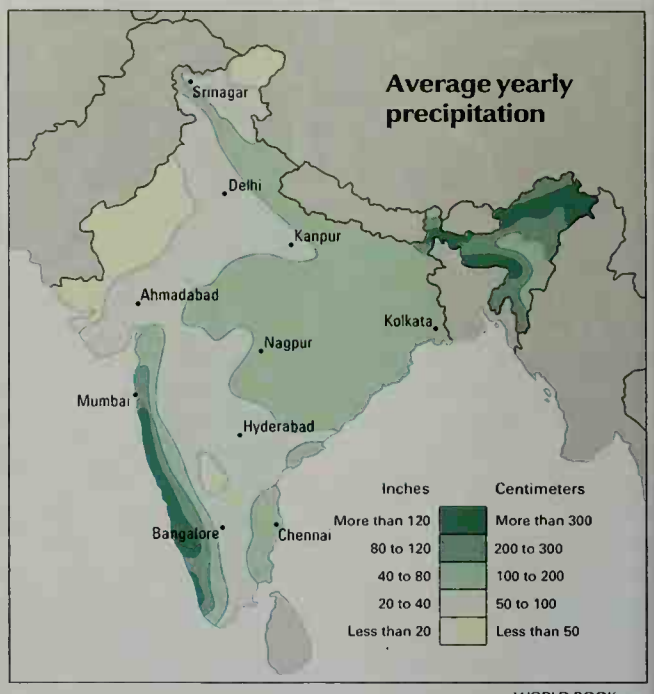
daily temperatures during the cool season. Days are warm, but temperatures sometimes drop below freezing at night. In the eastern part of the Northern Plains and in the Deccan, the temperature never reaches freezing.

The hot season lasts from March to June, though the Northern Plains and the Deccan are hot for much of the year. In the hot season, temperatures in the plains routinely go up to 115 °F (45 °C). Temperatures often rise to 123 °F (49 °C) in the desert region. Temperatures on the coastal plain average 85 to 90 °F (29 to 32 °C). In the Deccan, daytime temperatures in the hot months generally average from 90 to 100 °F (32 to 38 °C).

The rainy season can last from June to September. However, India usually receives rain from five to seven weeks during this period. During the rainy season, seasonal winds called *monsoons* blow across the Indian Ocean and pick up moisture on the way. The monsoons, which strike from the southeast or the southwest, bring heavy downpours. Although there is some rain at other times of the year, most of India receives its rain through the monsoons.

There is much Indian lore about the monsoons, which provide relief after months of scorching heat. The monsoons also are of great importance to India's agricultural production and the health of the economy. If the monsoons bring enough rain to the country, crops will grow. Sometimes the rains fail to arrive on time, and crops are poor as a result. Some monsoons drop too much rain and cause rivers to overflow, crops to be ruined, villages to be washed away, and many lives to be lost.

Rain falls most heavily in northeastern India. Some hills and mountain slopes in this region receive an average of about 450 inches (1,140 centimeters) of rain a year. The world's heaviest recorded rainfall for a one-year period fell at Cherrapunji. This village had almost 1,042 inches (2,647 centimeters) of rain from August 1860 to July 1861. The Thar Desert in the northwestern part of the country receives less than 10 inches (25 centimeters) of rain a year. Some sections of the desert get less than 4 inches (10 centimeters) of rain annually.



WORLD BOOK map

Rainfall in India varies greatly during the year. The heaviest rainfall occurs in summer, when winds called *monsoons* blow from the southwest, bringing moisture from the Indian Ocean.

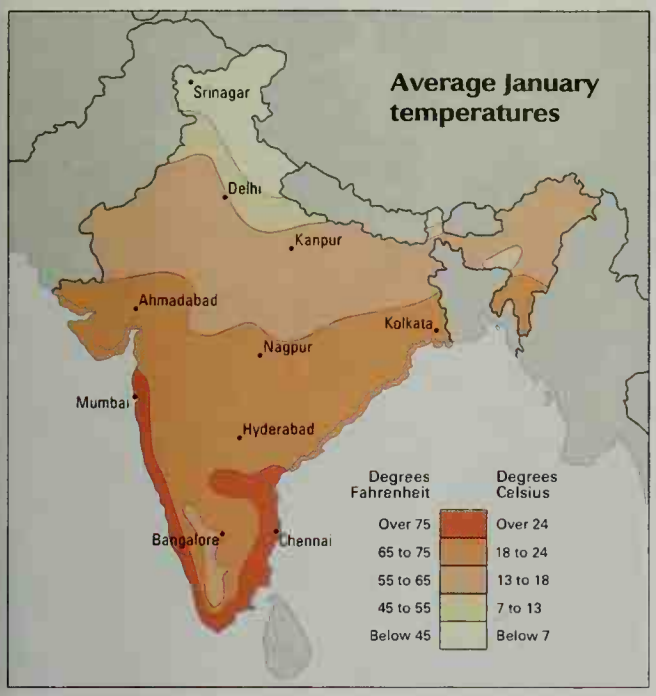
Economy

India has one of the largest economies in the world in terms of its *gross domestic product* (GDP). Gross domestic product is the value of all goods and services produced in a country in a year. However, India has such a large population that the country has an extremely low per capita GDP. This figure is determined by dividing a nation's GDP by its population. As a result of its low per capita GDP, India is considered a developing country and one of the poorest countries in the world.

Until 1991, the Indian government firmly controlled the economy. It owned all major industries. It also

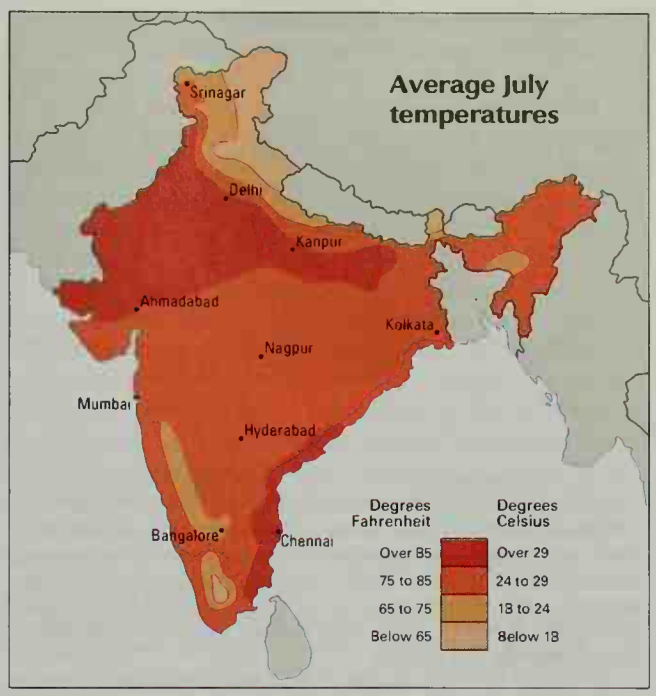
© Paolo Koch, Photo Researchers

The rainy season in India extends from June to September. During those months, seasonal winds called *monsoons* blow across the Indian Ocean, picking up moisture that brings heavy downpours. Monsoons frequently cause flooding. A monsoon created problems for traffic in the northern city of Varanasi (also called Banares or Benares), *left*.



WORLD BOOK map

In January—during the cool season—cool, dry monsoons from the northeast bring mild temperatures to northern India. Most of southern India has high temperatures all year.



WORLD BOOK map

Temperatures in July, a rainy season month, are not as high as during the hot season, which lasts from March to June. Much of the Himalayan region remains cool all year.

placed heavy *duties* (taxes) on the import of goods from other countries and allowed foreign companies to invest and trade only under strict supervision. Since 1991, however, India has moved closer to a free enterprise system. The government has encouraged foreign investment and corporate ownership, ended many government monopolies, and greatly reduced duties on goods imported from other countries.

Agriculture provides the main source of income for a majority of the population. Farms cover about half the country's land. About three-fourths of the farmland is used to grow India's major grains and *pulses* (seeds, beans, and lentils). The major grains include rice, wheat, corn, sorghum, and millet. Rice leads all crops in land area. Only China produces more rice than India.

India is the world's leading producer of such crops as cauliflower, a fiber called jute, mangoes, millet, pulses, sesame seeds, and tea. It is a major grower of bananas, cabbages, coconuts, coffee, cotton, onions, oranges, peanuts, potatoes, rapeseeds, rubber, sugar cane, and tobacco. Cardamom, ginger, pepper, turmeric, and other spices are also important products.

In the past, India imported much of its food. Today, however, it is essentially *self-sufficient* in food production—that is, it produces enough food to meet its needs. The increase in agricultural production came about partly because of the Green Revolution, the introduction of high-yielding seeds in the 1960's. Improved farming techniques, greater mechanization, and irrigation have also increased agricultural production. In addition, farmers are paid high prices for their crops to encourage them to grow more, and many rural development programs make credit and machinery easily available.

Large farms, such as those in the Punjab, which is called India's "breadbasket," grow food for sale. However, most Indian farmers are subsistence farmers, who grow crops mainly to feed their families, not for commercial purposes. About two-thirds of India's farmers own the land on which they work.

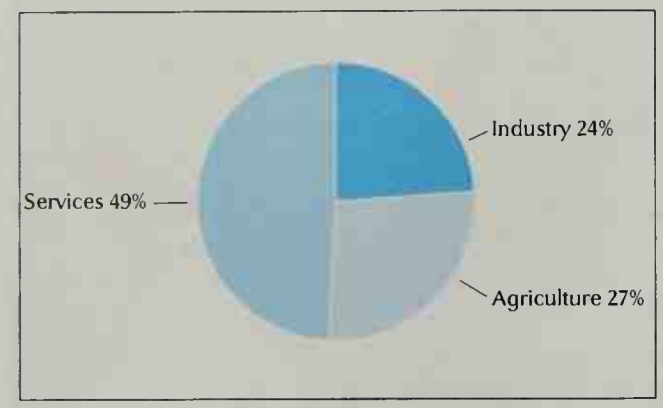
Most Indian farms are small. Half the farms are less than 2 $\frac{1}{2}$ acres (1 hectare) in area, and only a few are larger than 25 acres (10 hectares). Indian farms are so small in part because of inheritance customs. After a farmer dies, his farm is divided among his sons. After these sons die, the land is further divided among their sons. With each generation, the size of the farm decreases, and it may become too small to provide a living.

India has more cattle than any other country. The animals serve a variety of purposes. In most of rural India, farmers still use oxen to plow the land. Dairy farming is important. Milk from water buffaloes is also sold commercially. The hides of cattle and water buffaloes are used to produce leather and leather goods. There is almost no beef farming in India, because Hindus are not supposed to eat beef.

Manufacturing. India is one of the world's top producers of iron and steel. Huge iron and steel mills operate in Bhilai, Bokaro, Durgapur, and Raurkela. Indian factories use the iron and steel to manufacture such products as aircraft, automobiles, bicycles, electrical appliances, military equipment, railway cars, sewing machines, and tractors. Factories also produce cement, drugs, dyes, fertilizer, food products, industrial chemicals, paper, pesticides, petroleum products, and wood products. One of the largest employers in India is the textile industry. Cotton mills are in western India, near Mumbai and Ahmadabad.

Millions of Indians work at home or in small plants. Some of these workers produce cotton textiles on hand looms. Others manufacture matches, incense sticks, and a variety of handicrafts, including brassware, embroidered textiles, jewelry, leather goods, and woodcarvings. Although craft goods are made throughout the country, individual regions tend to specialize in certain

India's gross domestic product



India's gross domestic product (GDP) was $427,206,000,000 in 1998. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, government, and personal services; finance, insurance, real estate, and business services; trade, restaurants, and hotels; transportation, storage, and communication; and utilities. *Agriculture* includes agriculture, forestry, and fishing. *Industry* includes construction, manufacturing, and mining.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers Number of persons	Employed workers Percent of total
Agriculture, forestry, & fishing	27	211,554,000	59
Community, government, & personal services	17	65,343,000	18
Manufacturing	17	31,700,000	9
Trade, restaurants, & hotels	15	23,546,000	7
Transportation, storage, & communication	8	8,865,000	2
Finance, insurance, real estate, & business services	6	2,919,000	1
Construction	5	6,129,000	2
Utilities	3	3,054,000	1
Mining	2	1,936,000	1
Total	100	355,046,000	100

Figures are for 1998.
Source: *World Book* estimates based on data from Ministry of Statistics, Government of India.

ones. For example, Kashmir is famous for carpets, South India for brass, and Rajasthan for puppets.

Mining. India has valuable deposits of a variety of natural resources. The country is one of the world's leading producers of iron ore. Iron ore deposits lie mainly in Bihar, Madhya Pradesh, and Orissa. India also has large deposits of coal and petroleum. Coal accounts for about 40 percent of the yearly value of all minerals mined in India, and petroleum accounts for about 35 percent. Huge coal deposits lie in Bihar, Orissa, Madhya Pradesh, and the western end of West Bengal. There are some inland deposits of petroleum, mainly in Assam and Gujarat, but most drilling is off the shore of Mumbai.

India exports much manganese ore, which is used in steelmaking. The country has important deposits of bauxite, chromite, gypsum, limestone, magnesite, mica, natural gas, and titanium. There are smaller deposits of copper, lead, sulfur, and zinc. India also has supplies of two radioactive metals, thorium and uranium.

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Workers plant rice seedlings in a flooded paddy in the southern state of Andhra Pradesh. India is a leading world producer of rice. Farmland covers about half the country's area.

India has deposits of a number of precious metals and stones, including diamonds, emeralds, gold, and silver. Cut diamonds are one of India's biggest exports.

Forestry and fishing. Forests cover only about 10 percent of India. India's forestland has shrunk rapidly since the mid-1900's, because each year more trees are cut down than are planted. Conservation movements are now working to restore Indian forests. In most cases, the previous forests, which had a variety of trees, are being replaced by fast-growing eucalyptus or pine trees. Villagers cut down trees for use as fuel. Deodar cedar, rosewood, sal, and teak trees are cut for timber.

Fishing is a way of life for millions of people who live on India's coasts, and it is one of the chief industries in such coastal states as Andhra Pradesh, Kerala, Orissa, Tamil Nadu, and West Bengal. The main varieties of fish caught from the seas around India include mackerel, perch, prawn, and sardines. Carp and catfish are the most important freshwater fish.

Service industries are economic activities that provide services, rather than produce goods. A growing urban population and increasing commercial and communication links between India and the rest of the world have led to a dramatic expansion of the country's service industries. Government is the largest service industry. Other important service industries include business, computer programming, education, finance, health care, insurance, public administration, real estate, social work, tourism, transportation, and utilities.

India's major stock exchange is in Mumbai, which is the nation's business, finance, and trading capital. Kolkata ranks as the world leader in the wholesale trade of jute. Bangalore is the center of the country's computer industry.

Energy supply. India has rich deposits of coal, and petroleum production is increasing. Nevertheless, India

still imports large amounts of petroleum because it uses more than it produces. Plants that burn petroleum or coal generate about 80 percent of India's electric power. Most of the rest comes from hydroelectric plants.

International trade. The value of India's imports is greater than the value of its exports. The main import is petroleum, which comes from the Middle East. Other imports include chemicals, fertilizer, industrial machinery, and pearls and gemstones. Exports include chemicals, cotton textiles and clothing, cut diamonds and jewelry, engineering goods, handicrafts, iron ore, leather goods, and tea. India's main trading partner is the United States. Its other trading partners include Germany, Japan, Saudi Arabia, and the United Kingdom.

Transportation. India's railway system, which is owned and operated by the government, is one of the largest in the world. It has over 7,000 stations and more than 38,000 miles (62,000 kilometers) of track. It is also the single largest employer in the country. Railroads transport most goods in India and serve as the main carrier of passengers. About 4 billion passengers travel by train in India annually. The government keeps the price of train travel low enough for most people to afford it.

India is well connected by roads, but the roads generally are not well maintained. Each of the states has a long-distance bus system. There are many private bus companies as well, which operate mainly in the tourist regions or between large cities.

Although few Indians own an automobile, car and motorcycle ownership is growing rapidly. Many people ride bicycles. In urban areas, buses are a popular form of transportation. In rural areas, many people travel on buggies or carts drawn by horses or oxen. The Brahmaputra, Ganges, and other major rivers carry boat traffic.

The government owns and operates two major airlines. Air India provides international service to many countries throughout the world. Indian Airlines flies within India and to nearby countries. Several private airlines also operate within India. Chennai, Delhi, Kolkata, Mumbai, and Trivandrum (also spelled Thiruvananthapuram) have major airports.

Communication. Telephone and telegraph services reach throughout India. However, few families have telephones. In towns and cities, especially, public telephones are widely available.

The radio remains the main source of news for most Indians. However, almost every village with electric power has at least one television set, and an entire village may gather around it for a film or special program. The number of connections to cable and satellite sys-

Economy of India

Agriculture is a major economic activity throughout much of India. This map shows the nation's leading agricultural areas and major farm products. It also indicates the country's chief forestlands, fisheries, manufacturing centers, and mineral deposits.

WORLD BOOK map

© Emil Muench, Photri

Traditional crafts play an important part in Indian manufacturing. This woman uses a carved wood block to paint a design on fabric. Millions of people work at home or in small plants.

WORLD BOOK photo by David R. Frazier

Modern technology is growing rapidly in India's cities. The communications laboratory shown above is located in Bangalore, the center of the country's computer industry.

tems is growing rapidly, making more channels and a wider variety of television programs available to many viewers.

India has a lively newspaper culture. Newspapers are privately owned, and they freely criticize the government. India has about 3,500 daily newspapers, which are published in a variety of languages. The major English-language newspapers include the *Times of India, Indian Express, Statesman,* and *The Hindu.* These papers are published nationally and are highly influential.

History

Earliest times. People have lived in what is now India for at least 200,000 years. About 4,500 years ago, a civilization began to flourish in the Indus Valley in what are now western India and Pakistan. Archaeological excavations in the early 1920's uncovered extensive ruins of two cities named Harappa and Mohenjo-Daro.

The people of Harappa, Mohenjo-Daro, and other Indus Valley cities had a system of writing. However, scholars have not yet succeeded in deciphering this script. The Indus Valley people also had systems of counting, measuring, and weighing. About 1700 B.C., the Indus Valley civilization gradually broke up. Scholars believe that changing river patterns, including a series of floods, may have caused the end of the culture.

The Aryans. About 1500 B.C., groups of warlike people left their homes in central Asia, possibly near the Caucasus Mountains, and came to India. These people called themselves *arya* (kinsmen or nobles). They are now known as the Aryans.

When the Aryans arrived in India, they found people with an advanced civilization living there. These people, called the Dravidians, lived in towns and grew crops. The Aryans gradually conquered the Dravidians and drove some of them southward. Eventually, the Aryans extended their rule over all of India except the south.

The Aryans tended sheep, goats, cows, and horses. They measured their wealth in herds of cattle. Over time, the Aryans settled into villages. Each village or group of villages was led by a headman and council.

Over many centuries, the caste system became established. The Brahmans—the priests—were the highest caste and the Shudras, who may have been Dravidians, were the lowest. The Brahmans perfected Sanskrit, the language of the Aryans; conducted elaborate rituals and sacrifices; and passed sacred knowledge from one generation to another. Beginning about 1400 B.C., the earliest known Hindu scriptures—the Vedas—were composed. The most important Hindu sacred writings, called the Upanishads, appeared between 800 and 600 B.C.

In the 500's and 400's B.C., two religions were founded in India. The great religious and social reformer Siddhartha Gautama, who became known as Buddha (Enlightened One), founded Buddhism. Another reformer, Mahavira, founded Jainism. Both religions rejected the authority of the Vedas and the Brahmans, and both spread rapidly throughout India.

Persian and Greek invasions. About 518 B.C., Persians gained control of the Gandhara region in the northwest, now in Pakistan. Alexander the Great of Macedonia led his Greek army into India in 326 B.C., but he went only as far as the Beas River in the northwest. He wanted to push eastward to the Ganges River, but his troops, tired and worn out by disease, refused to go farther. Alexander left India and named some of his generals as *satraps* (governors) of the conquered provinces. In a few years, Indian forces drove most of the satraps out.

The Mauryan Empire was established by Chandragupta Maurya about 324 B.C. By the end of Chandragupta Maurya's rule in about 298 B.C., the empire extended over nearly all of northern India and into what are now Afghanistan and parts of central Asia.

Chandragupta Maurya's grandson Ashoka became

one of India's most famous emperors. He ruled from about 272 to 232 B.C. In 261 B.C., Ashoka conquered the kingdom of Kalinga (now Orissa). The bloodshed caused by his war of conquest left Ashoka stricken with sorrow and regret. Ashoka gave up war.

Ashoka spent the rest of his life trying to spread a message, based on Buddhist teachings, that emphasized nonviolence and the importance of duty. He sent members of his family as Buddhist missionaries to other parts of India and to what is now Sri Lanka. Ashoka had laws and moral teachings carved on great pillars that were installed throughout his kingdom. India's state emblem, a group of lions, is taken from one of these pillars.

The Mauryan Empire began to break up after the death of Ashoka in 232 B.C. The empire ended about 185 B.C. For about the next 500 years, groups of central Asian peoples, including the Scythians and the Kushans, moved into northern India. The Kushans established a dynasty in northern India around A.D. 50.

The golden age. Indian emperors of the Gupta dynasty reunited northern India about 320. Gupta territory eventually extended to what is now Afghanistan in the northwest and to the Vindhya mountains in the south. The Gupta Empire, which lasted until about 500, is often referred to as India's "golden age." Indian art, literature, mathematics, philosophy, and science achieved great heights under the Guptas, especially during the reign of Chandragupta II, who ruled from about 375 to about 415. India's most famous dramatist and poet, Kalidasa, wrote works of great charm and beauty in this period. The finest frescoes at Ajanta were also painted at this time, and many Hindu temples were built. A system of medicine called Ayurveda also developed about this time.

Southern India. From about 50 B.C. to about the A.D. 1000's, several dynasties competed for control of southern India and established a great civilization there. These dynasties included the Andhras, also called the Satavahanas; the Cholas; and the Pallavas. Southern India forged trading links with Southeast Asia that lasted for centuries. Indian traders and other voyagers spread Indian culture throughout Southeast Asia.

Period of invasions. From about 455 to the early 1500's, armies from what are now Afghanistan, central Asia, and Iran invaded India. First, the Huns invaded from central Asia. Muslim armies came from Arabia in the early 700's. Mahmud of Ghazni, a warrior from Afghanistan, began a series of 17 raids into India about 1000. During these attacks, Mahmud destroyed Hindu temples and looted Indian cities.

In 1206, the Muslim general Qutb ub-din Aybak proclaimed himself *sultan* (ruler) of northern India and established the Delhi Sultanate. In 1398, the armies of the central Asian leader Timur, also known as Tamerlane, swept over India. Timur sacked Delhi before returning to his capital at Samarqand (Samarkand) in what is now Uzbekistan. After Timur's attack, the Delhi Sultanate began to break apart.

The Mughal Empire. In 1526, a central Asian leader named Babur defeated Ibrahim Lodi, the last sultan of Delhi, at the Battle of Panipat. Babur, a descendant of both Timur and the Mongol conqueror Genghis Khan, then established the Mughal Empire in India. Babur ruled until 1530 and conquered much of northern India.

Babur's grandson Akbar became the greatest Mughal emperor. He ruled from 1556 to 1605. He expanded his empire as far west as what is now Afghanistan and as far south as the Godavari River. Akbar was a tolerant ruler. A Muslim, he won over the Hindus of India by making many of their leaders government administrators and military commanders, and by giving them honors. The Mughal Empire under Akbar was among the most powerful in the world at that time.

Akbar's grandson Shah Jahan, who ruled from 1628 to

Important dates in India

c. 2500 B.C. The Indus Valley civilization began to flourish.

c. 1500 B. C. The Aryans invaded India.

c. 1400 B.C. The earliest known texts of the Hindu faith—the Vedas—were beginning to be composed.

326 B.C. Alexander the Great reached what is now India.

A.D. 320-c. 500 The Gupta dynasty unified northern India.

1498 Vasco da Gama of Portugal reached India.

1526 The Mughal Empire was established by Babur, a Muslim ruler from central Asia, who conquered India.

1757 The British East India Company's agent Robert Clive won the Battle of Plassey. The company soon gained control of Bengal.

1774 Warren Hastings, the first British governor general of India, took office.

1857-1859 The British put down the Indian Rebellion, an uprising against their rule by Indians in northern and central India.

1858 The British government took over the direct rule of India from the East India Company.

1885 The Indian National Congress was formed.

1906 The All-India Muslim League was organized.

1919 Demonstrations against British rule became widespread. In an incident known as the Amritsar Massacre, British troops in Amritsar opened fire on an unarmed crowd of Indians.

1920 Mohandas K. Gandhi became the leader of the Indian National Congress and started a program of nonviolent disobedience against the British.

1935 The British government created a new constitution that gave Indians more political power.

1940 The Muslim League demanded that a separate Muslim country, Pakistan, be carved out of India.

1947 India became independent on August 15, the day after Pakistan was created. Jawaharlal Nehru became India's first prime minister.

1947-1949 India and Pakistan fought over Kashmir.

1948 Mohandas Gandhi was assassinated.

1950 India's Constitution took effect.

1965 India and Pakistan fought a second war over Kashmir.

1966 Indira Gandhi, Nehru's daughter, became India's first woman prime minister.

1971 India assisted East Pakistan in a war against West Pakistan. The West was defeated, and East Pakistan became the independent nation of Bangladesh.

1984 Indira Gandhi was assassinated. Her older son, Rajiv, then became prime minister.

1991 Rajiv Gandhi was assassinated.

1996 The Congress Party, which had ruled India for all but four years since the nation won independence in 1947, was voted out of office, and India entered a period of coalition governments.

The Mauryan Empire, which lasted from about 324 B.C. to 185 B.C., united almost all India for the first time. The empire's capital was Pataliputra (now Patna).

The Gupta Empire extended across northern India from about A.D. 320 to about 500. At this time, India became a center of art, learning, and medicine.

WORLD BOOK maps

The Mughal Empire was established by central Asian Muslims in 1526. By about 1600, the Mughals ruled most of India. The empire lasted until the 1700's.

1658, built a new capital in Delhi. He was also responsible for the construction of the Taj Mahal at Agra and many other great buildings.

Aurangzeb, one of Shah Jahan's sons, became head of the Mughal Empire in 1658. Aurangzeb was a strict Muslim and a harsh ruler. He reimposed a tax on Hindus that had been abolished by Akbar. Hindus hold him responsible for destroying many Hindu temples and trying to forcibly convert Hindus to Islam. His policies caused many revolts. Under the Hindu leader Shivaji Bhonsle, the Marathas of western India launched attacks against Aurangzeb's empire. Many local leaders in the south also rebelled. Partly as a result of Aurangzeb's rule and his costly wars, the Mughal Empire began to fall apart.

The coming of the Europeans. The first European explorer to reach India was Vasco da Gama of Portugal. He arrived in Kozhikode (also known as Calicut) in 1498. At the time, Portugal was challenging Turkish Muslims and traders from Italian city-states for control over the European trade with Asian countries in silk, spices, and other highly valued goods. The Portuguese gained control over Goa and some other areas on the western coast of India.

In 1600, Queen Elizabeth I of England granted a charter to create a company to open trade with India and East Asia. This company, the East India Company, got permission from the Mughal Emperor Jahangir, Akbar's son, to trade in India. The company soon set up trading posts and forts at Bombay (Mumbai), Calcutta (Kolkata), and Madras (Chennai). During the 1600's, the English became the leading European power in India. Meanwhile, the French established a trading post at Pondicherry.

The rise of the East India Company. By the mid-1700's, little remained of the Mughal Empire, and there was no effective central power. In these circumstances, the Europeans in India prospered. The East India Company expanded its trade and increased its political power. It also began collecting taxes in some regions. When Indian rulers refused to agree to the company's terms, the company used force against them.

At the Battle of Plassey in 1757, the forces of Robert Clive, an agent of the East India Company, defeated the army of the *nawab* (Mughal governor) of Bengal. Most historians regard this British victory as the start of the British Empire in India, though most of the country remained under the rule of Indian princes. Over the next 100 years, however, British political influence and territorial control expanded. In 1774, Warren Hastings was appointed the company's first governor general of India.

The Indian Rebellion. Through the years, resentment against British rule grew, especially in the north. Land taxes imposed by the British caused many difficulties for farmers. Many people went hungry. British land reforms took land from many Indian owners. In addition, many Indians resented what they regarded as a growing British interference in Indian customs and religion.

Resentment against the British led to many small rebellions and, in 1857, to a widespread uprising. The 1857 rebellion, sometimes called the Sepoy Rebellion or Sepoy Mutiny, began at an army base in Meerut, near Delhi. There, Indian soldiers called *sepoys* revolted after British officers instructed them to bite open rifle cartridges believed to have been greased with cow and hog fat. Both Hindus and Muslims objected to the order. The religious beliefs of the Hindu sepoys forbade them to eat beef, and the Muslim sepoys could not eat pork.

The Indian Rebellion quickly spread from Meerut to the rest of northern and central India. However, the rebels were poorly organized, had few weapons, and lacked good leadership. By 1859, they had been defeated. Although the rebellion had failed, the British had faced a serious threat to their rule.

British India. In 1858, the British government decided to govern India directly. This direct rule is often called the British Raj. *Raj* means *rule* or *administration.* Parliament took control of the East India Company's Indian possessions, which became known as British India. In most other parts of India, called the *princely,* or *native, states,* the British governed indirectly, through local rulers. A few small areas of coastal land remained French or Portuguese colonies until the mid-1900's.

The British monarch appointed an official called a *viceroy* to govern British India. An executive council of five members—all British and all appointed by the monarch—helped the viceroy. The viceroy appointed from 6 to 12 additional members, who met together with the executive council to form a legislative council. A few Indians could serve on the legislative council.

British India was divided into several provinces. An appointed governor or lieutenant governor headed

Manuscript painting (late 1500's-early 1600's); Musée Guimet, Paris (Giraudon/Art Resource)

Babur, *seated at the far left,* was a Muslim ruler from central Asia who founded the Mughal Empire in 1526. Babur conquered much of northern India before his death in 1530.

each province. The provinces also had their own executive council and legislative council.

The United Kingdom placed a representative, called a *resident,* in each princely state. The resident advised the local prince about political and economic matters. The local prince had no power to make laws relating to foreign affairs, defense, relations with other princely states, and certain other matters. In internal affairs, however, the local prince generally had complete authority.

In 1876, the British Parliament gave Queen Victoria of the United Kingdom the title Empress of India. Although the British did not further expand their territory within India, they were involved in several wars in which they used Indian troops. Indian troops serving under British officers fought the Second Afghan War (1878-1881). This war helped establish India's boundary with Afghanistan. British India defeated the Burmese in the Third Burmese War (1885). Burma (now Myanmar) then became a province of India. It remained a part of India until 1937.

In the second half of the 1800's, the British built railroad, telephone, and telegraph systems in India. They also established universities. Although the British enlarged the Indian irrigation system, agricultural production improved only slightly. Poverty levels remained high. The British spent little money on elementary education and did little to promote industrialization.

Rise of Indian nationalism. Indians did not generally feel content about British rule in India. Indians lacked equal job opportunities. They were not allowed to advance to high positions in government service or to become officers in the army. In 1885, a number of Indian lawyers and professionals formed the Indian National Congress. Members of the organization belonged to various religions and came from all parts of India. Congress members debated political and economic reforms, the future of India, and ways for Indians to achieve equal status with the British.

Some Muslims believed the Indian National Congress was a Hindu organization aiming for Hindu rule. In 1906, several Muslim leaders, encouraged by the British, formed the All-India Muslim League. Members of the organization sought to give the Muslims a voice in political affairs. However, most Muslims continued to support the Indian National Congress.

In 1905, the British divided the state of Bengal into separate Hindu and Muslim sections. Indians protested this action with a boycott of British goods and a series of bombings and shootings. In an effort to stop the violence, the British introduced the Morley-Minto Reforms of 1909. These reforms enlarged the viceroy's executive council to include an Indian. They also allowed Indians to elect representatives to the provincial legislative councils. In 1911, the British reunited Bengal.

When World War I broke out in 1914, the United Kingdom said that India was also at war with Germany. Indian troops fought in many parts of the world. In return for support, the British promised more reforms and agreed to let Indians have a greater role in political affairs. But protests against the British continued.

In March 1919, the British passed the Rowlatt Acts to try to control protests in India. The acts attempted to restrict the political liberties and rights of Indians, including the right to trial by jury. But demonstrations against the government increased in response to the acts.

On April 13, 1919, thousands of Indians assembled in an enclosed area in Amritsar. Troops entered the meeting place and blocked the entrance. The British commander then ordered the soldiers to open fire on the unarmed crowd. The shots killed about 400 people and wounded about 1,200. This event, called the Amritsar Massacre, was a turning point. From then on, Indians demanded complete independence from British rule. The British promised more reforms, but at the same time, they tried to crush the independence movement.

The Montagu-Chelmsford Reforms were passed in late 1919 and went into full effect in 1921. The reforms increased the powers of the provincial legislative councils, where Indians were most active. The central legislative council was replaced by a legislature with most of its members elected. However, the viceroy and the governors still had the right to veto any bill. The Indians did not believe the reforms gave them enough power.

By 1920, Mohandas K. Gandhi had become a leader in the Indian independence movement and in the Indian National Congress, which had become the most important Indian political organization. Gandhi persuaded the Congress to adopt his program of *nonviolent disobedience,* also known as *nonviolent noncooperation.* Gandhi's program asked Indians to boycott British goods, to

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Mohandas K. Gandhi led the people of India to independence. He was assassinated in 1948, the year after achieving his goal.

refuse to pay taxes, and to stop using British schools, courts, and government services. As a result, some Indians gave up well-paying jobs that required them to cooperate with the British. Gandhi changed the Indian National Congress from a small party of educated men to a mass party with millions of followers.

New Constitution. In 1930, Gandhi led hundreds of followers on a 240-mile (386-kilometer) march to the sea, where they made salt from seawater. This action was a protest against the Salt Acts, which made it a crime to possess salt not bought from the government. The salt march and other acts of civil disobedience in the early 1930's led the British to give the Indian people more political power. In 1931, Gandhi and the viceroy, Lord Irwin, signed an agreement. Gandhi agreed to give up his campaign of civil disobedience. The British agreed to release thousands of political prisoners.

The Government of India Act of 1935 created a new constitution which gave provincial legislatures control over lawmaking in the provinces. It also increased the representation of Indians in all branches of government. However, the viceroy and the governors still kept their veto power over all bills, and the government controlled finances. As a result, many important changes that Indians wanted were never approved by the government.

Meanwhile, the Muslim League had become more politically active. In 1934, Mohammad Ali Jinnah, who had been an important Congress leader, was chosen to head the Muslim League. Under Jinnah's leadership, the league won a number of seats in the provincial legislatures, and membership increased rapidly. However, the provincial elections of 1937 showed that most Muslims still supported the Indian National Congress.

Jinnah increased his political activity and declared that the Congress could not speak for Muslims. In 1940, he demanded that a new country be carved out of India for Muslims. The name *Pakistan*, which means *land of the pure* in the Urdu language, came to be used for this proposed nation. According to Jinnah, India was to be for Hindus, and Pakistan for Muslims.

World War II (1939-1945). The United Kingdom declared war on Germany on Sept. 3, 1939. As it had done in World War I, the British again said that India was also at war with Germany. Indian leaders were angered because they had not been consulted. They continued to demand independence. The British promised independence for India after the war. But members of the Indian National Congress demanded immediate self-government instead, and they refused to support the war effort.

Nevertheless, India was already helping the United Kingdom. Indian troops fought in Africa and the Middle East. Indian factories produced supplies for the British and Allied armies. The British exported coffee, tea, rice, and wheat from India to Allied nations. The export of these products contributed in part to the Bengal famine of 1943, in which about 3 million Indians died.

In December 1941, Japan entered the war on Germany's side. Within a few months, Japanese troops had captured Burma. The Japanese invaded eastern India in March 1944. Many thousands of Indian troops decided to aid the Japanese in the hope of driving the British out of India. These soldiers, most of whom had been captured by the Japanese when they seized Burma, called themselves the Indian National Army. But British and Indian troops soon drove them back.

During the war, the United Kingdom continued to hold talks with the Indian National Congress. In a final effort to free India of the British, Gandhi launched another civil disobedience campaign, called the Quit India Movement, in August 1942. In response, the British

The British East India Company controlled much of India by the early 1800's. Areas not held directly were allied states, except for the Maratha Confederacy.

British India. In 1858, the United Kingdom took over East India Company lands and indirect control of the other states. It gradually expanded India's boundaries.

WORLD BOOK maps

Independent India was founded on Aug. 15, 1947, the day after the northeast and northwest became Pakistan. Burma and Ceylon won independence in 1948.

jailed all Congress leaders for the rest of the war. The Muslim League, on the other hand, cooperated with the British, with the understanding that their demands for a separate nation would receive serious consideration.

Independence and partition. At the conclusion of the war in 1945, Congress leaders were released and negotiations for independence were resumed. The British declared early in 1946 that they would grant India independence if Indian political leaders could agree on a form of government. The United Kingdom sent a special Cabinet mission to India, but the Congress and Muslim League could not settle their differences.

To show its strength and to warn the British not to make a separate agreement with the Congress, the Muslim League declared Aug. 16, 1946, as Direct Action Day. On that day, Muslims held nationwide demonstrations calling for the establishment of Pakistan. Bloody rioting broke out between Muslims and Hindus in Calcutta (now Kolkata). Similar violence later occurred elsewhere in India. In 1947, Indian and British leaders agreed to *partition* (divide) the country into India and Pakistan. They saw no other way of bringing to an end the violence between Hindus and Muslims.

India became an independent nation on Aug. 15, 1947. Pakistan had become an independent nation the day before. Partition was accompanied by more violence and bloodshed. More than 10 million people became refugees, as Hindus and Sikhs in Pakistan fled to India, and Muslims in India fled to Pakistan. About half a million people were killed in Hindu-Muslim riots.

Gandhi also fell victim to violence. On Jan. 30, 1948, while on his way to a prayer meeting in New Delhi, he was assassinated. A Hindu fanatic who hated Gandhi for his tolerance toward Muslims and disagreed with Gandhi's policy of nonviolence shot him to death.

Although British India had become partitioned, an agreement also had to be reached with the princely states. Most local rulers agreed to merge their states into India. In return, the Indian government offered them annual payments. A few states joined Pakistan.

One state that initially merged into neither India nor Pakistan was Kashmir. Its ruler was Hindu, but the majority of its people were Muslims. Pakistani Muslims launched an invasion to take Kashmir by force, and Pakistan laid claim to the state. Kashmir's ruler responded by seeking India's protection and by making Kashmir part of India. The war between India and Pakistan lasted until 1949, when the United Nations (UN) arranged a cease-fire and set up a truce line. See **Kashmir**.

In India, Jawaharlal Nehru, a close associate of Gandhi, became the first prime minister after independence. A constituent assembly drew up a new constitution, which the assembly approved in November 1949. The Constitution went into effect on Jan. 26, 1950. India celebrates January 26 as a national holiday, Republic Day.

India in the 1950's and early 1960's. India's first general election was held in 1951 and 1952. The Congress Party, under Nehru's leadership, won a huge majority of the seats in India's Parliament. Nehru sought to develop the country and raise the standard of living. Under Nehru, the central government ran the economy and controlled industry.

In 1951, India began its first *five-year plan,* a program designed to improve the country's standard of living. As a result of the plan, agricultural and industrial production grew rapidly, and school enrollment rose sharply. A rationing system enabled people to buy essential food items at low prices. New laws made it possible for more poor farmers to own the land they worked on. Women gained the right to divorce and to inherit property. Malaria was brought under control.

Nehru also sought to achieve the political unity of India. France gave up the last of its Indian territories in 1954, but Portugal refused to do so. It still had three small colonies in India—Damão (now Daman), Diu, and Goa. In 1961, Indian troops invaded these areas and defeated the Portuguese forces there. Goa became a state in 1987. Daman and Diu remained a territory.

Regional, language, and ethnic differences among Indians created difficulties for national unity. In 1953, after much pressure on the Indian government, the state of Andhra (now Andhra Pradesh) was created for Telugu speakers. In 1955, the States Reorganization Commission recommended the creation of other states based on language. At that time, the state boundaries were those that the British had drawn up. In 1956, most of India's major language groups were given their own states. Additional states based on language were created later.

In foreign affairs, Nehru adopted a position of nonalignment. During the Cold War, a period of intense rivalry between the United States and the Soviet Union, most nations were allied with one side or the other. Nehru, however, refused to support either side. He chose to use the UN to resolve international conflicts and strongly supported UN peacekeeping operations.

Border disputes between India and China erupted into armed violence in October 1962, when Chinese forces swept into northeastern India. In November, the Chinese pulled back, and a cease-fire took effect. Nehru, who had been surprised by the Chinese invasion, decided that military spending should increase. As a result, more of the budget went to the armed forces and less to education, health, and social reform.

India under Indira Gandhi. Nehru died in office in 1964. He was succeeded by Lal Bahadur Shastri, a member of his cabinet. In early 1965, fighting broke out along the Pakistan-India border, but Shastri and President Muhammad Ayub Khan of Pakistan quickly agreed to a

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Jawaharlal Nehru, *on horseback,* worked for independence with Mohandas Gandhi and became India's first prime minister.

cease-fire under UN supervision. There were many violations of the cease-fire, and later that year, Pakistan and India fought over Kashmir. Once again, a UN-sponsored cease-fire took effect.

In 1966, Shastri and Ayub Khan signed a peace treaty. Shastri died shortly after signing. A brief leadership struggle within the Congress Party followed Shastri's death. Nehru's daughter, Indira Gandhi, eventually became the prime minister in 1966.

In 1971, civil war broke out in Pakistan, and millions of East Pakistani refugees fled into India. India assisted East Pakistan in the fight against West Pakistan. West Pakistan was defeated , and East Pakistan became the independent nation of Bangladesh.

Gandhi had taken office during widespread unrest because of severe food shortages, unemployment, and other problems. The economic situation remained poor in the early 1970's, and there were many demonstrations urging her removal. In June 1975, a high court found Gandhi guilty of using illegal practices in her 1971 election campaign. Rather than resign, Gandhi had the president declare a state of emergency. She claimed that external enemies and internal forces of disorder were trying to break India apart. She had her opponents jailed and imposed strict censorship. In November 1975, the Supreme Court of India overturned her conviction.

In 1977, Gandhi declared the state of emergency over. Political prisoners were released, and preparations were made for elections that year. For the first time, the Congress Party lost, and the newly formed Janata Party came into office. But the Janata Party, which was a coalition of several parties, could not hold itself together. By 1980, elections had to be held. Gandhi's party, Congress-I (the *I* stood for *Indira),* won back power, and Gandhi once again became prime minister.

In the early 1980's, a militant Sikh movement grew in the Punjab. The leaders of this movement claimed that the Sikhs suffered from widespread discrimination. They wanted a separate state only for Sikhs. Some Sikhs carried out acts of terrorism and violence against people who opposed the movement. Sikh militants occupied the Golden Temple in Amritsar, the most sacred Sikh shrine. In 1984, government troops attacked the temple. The leaders of the militants died in the fighting. Many Sikhs were angry that their shrine had been attacked, and two Sikh members of Gandhi's security force assassinated her on Oct. 31, 1984. The assassination touched off riots in which several thousand Sikhs were killed. Gandhi's elder son, Rajiv, succeeded her as head of the Congress-I Party and as prime minister.

Religious and ethnic unrest. In the late 1980's, Muslim groups in Kashmir began to hold demonstrations against Indian rule. Many received the support of the Pakistani government. In 1989, the demonstrations turned violent. Since then, thousands of people have died as a result of clashes between Indian military forces and the Muslim groups.

In 1989 and 1990, violence between Hindus and Muslims erupted over the status of a *mosque* (Muslim place of worship) in the town of Ayodhya in the state of Uttar Pradesh. Some Hindus claimed that a Muslim ruler of the 1500's had built the mosque at the site after destroying a Hindu temple there. They also claimed that the Hindu god Rama was born where the mosque had been built. They demanded that the mosque be removed and a temple be built to honor Rama. In 1992, Hindu extremists destroyed the mosque. This action led to violence between Hindus and Muslims in many areas of India.

A number of ethnic separatist groups emerged in the 1980's and 1990's. They included the United Liberation Forces of Assam, which called for independence for Assam, and the Bodo movement, which favored autonomy for the region inhabited by the Bodo people. In 1993 and 1994, violence broke out, mainly in Manipur, between Nagas wanting independence and Kukis, who also live in the region. The clashes left hundreds of people dead and many villages destroyed.

During Rajiv Gandhi's term, the government came under suspicion of corruption. In 1989, the Congress Party lost its majority in Parliament, and Gandhi resigned. A coalition of parties briefly ruled, but new elections were soon called. While campaigning in May 1991, Gandhi was assassinated.

The 1991 elections returned the Congress Party to power, and P. V. Narasimha Rao became prime minister. Rao began to reform the Indian economy by reducing government control over it. In elections in 1996, the Congress Party suffered a major defeat. India then entered a period of coalition governments.

Recent developments. In May 1998, India carried out several nuclear tests and declared itself capable of producing and using nuclear weapons. Pakistan, India's long-time rival, responded by exploding several nuclear devices of its own.

In 2000, the Lok Sabha voted to create three new states for India: Jharkhand, formed from the southern part of the state of Bihar; Uttaranchal, from northern Uttar Pradesh; and Chhattisgarh, from Madhya Pradesh. The three states came into being in November 2000.

On Jan. 26, 2001, a powerful earthquake struck the state of Gujarat. Tens of thousands of people were killed, and many more were left homeless.

Fighting continued to break out in Kashmir from time to time. India and Pakistan found it difficult to overcome their mutual distrust.

In December 2001, armed terrorists attacked India's Parliament building. They killed or injured over 20 people, though no elected official was harmed. India

Wide World

Indira Gandhi was the first woman prime minister of India. She held that position from 1966 to 1977 and from 1980 to 1984.

blamed Pakistan for supporting the terrorists, a claim that Pakistan denied. The incident led both countries to build up military forces along their common border.

In 2002, rioting broke out between Hindus and Muslims in Gujarat. The riots resulted in the deaths of hundreds of people. The unrest was sparked by Hindu preparations to build a temple on the site in Ayodhya where the mosque had been destroyed in 1992. Tensions between India and Pakistan continued to rise. In May, militants in the disputed region of Kashmir attacked Indian outposts there. Troops on both sides began exchanging artillery fire, and the two countries seemed on the brink of war.

Vinay Lal and Anil Lal

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Questions

Who is the most powerful person in the Indian government?
What is the caste system?
What major religions were founded in India?
What are *monsoons?* Why are they important?
Why does Indian music sound different from Western music?
What are some of the methods Mohandas K. Gandhi used in his campaign for Indian independence?
How does climate affect the way people in India live?
What are the Vedas? About how old are they?
What conditions led to the Indian Rebellion? What ignited the rebellion?
What factors have had a negative effect on Indian unity?

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American Indian

Indian, American. The people now known as Indians or Native Americans were the first people to live in the Americas. They had been living there for thousands of years before any Europeans arrived.

The Vikings are believed to have explored the east coast of North America about 1000 and to have had some contact with Indians. But lasting contact between Indians and Europeans began with Christopher Columbus's voyages to the Americas. In 1492, Columbus sailed across the Atlantic Ocean from Spain. He was seeking a short sea route to the *Indies,* which then included India, China, the East Indies, and Japan. Europeans did not then know that North and South America existed. When Columbus landed in what is now known as the West Indies, he did not realize he had come to a *New World.* He thought he had reached the Indies, and so he called the people he met *Indians.*

Almost every Indian group had its own name. Many of these names reflected the pride of each group in itself and its way of life. For example, the Delaware Indians of eastern North America called themselves Lenape, which means *genuine people.* Today, many Indians refer to themselves as *Native Americans.*

No people lived in the Americas before the Indians arrived. Most scientists think the first Indians came to the Americas from Asia at least 15,000 years ago. Other scientists believe the Indians may have arrived as early as 35,000 years ago. At the time the Indians came, huge ice sheets covered much of the northern half of the earth. As a result, much of the earth that is now underwater was dry land. One such area that was dry then but is submerged now is the Bering Strait, which today separates Asia and North America. The Indians, following the animals that they hunted, wandered across this land, a distance of about 50 miles (80 kilometers). By 12,500 years ago, Indians had spread throughout the New World and were living from the Arctic in the north all the way to southern South America.

The Indians spoke hundreds of different languages and had many different ways of life. Some groups lived in great cities and others in small villages. Still others kept moving all year long, hunting animals and gathering wild plants.

The Aztec and the Maya of Central America built large cities. Some of the Aztec cities had as many as 100,000 people. The Maya built special buildings in which they studied the moon, the stars, and the sun. They also developed a calendar and a system of writing.

Many of the Indians of eastern North America lived in

Detail of *Great City of Tenochtitlan* (1929-1945), a fresco mural by Diego Rivera, National Palace, Mexico City (Robert Frerck, Woodfin Camp & Associates)

Highly developed Indian societies appeared in the Americas hundreds of years ago. One such civilization was the Aztec empire, in what is now southern Mexico. This painting shows people trading for corn and other goods in the busy marketplace of Tenochtitlan, the Aztec capital.

Modern powwows feature Native American music and dancing, *right*. These gatherings bring tribes together to celebrate their heritage. Most powwows welcome non-Indian visitors.

Woodcarving has long been a specialty of the Indians of the Northwest Coast of North America. The Tsimshian Indian artists below are carving family and clan symbols on a totem pole.

Franke Keating, Photo Researchers

Scott Blackman, Tom Stack & Assoc.

Detail of *Indians Hunting Buffalo with Bows and Lances* (about 1835) by George Catlin; The Newberry Library, Chicago, Edward E. Ayer Collection

Buffalo hunters on the Great Plains rode at full speed while chasing the animals, *above*. Buffalo meat was a major source of food for many Indians of this region. These Native Americans also used buffalo skins to make clothing and tepees.

A Navajo woman teaches her daughter how to weave on a traditional loom, *left*. In this way, one part of Navajo culture—the long-held custom of producing richly woven rugs and blankets—is passed along from one generation to the next.

Jerry Jacka

villages. They hunted and farmed, growing such crops as *maize* (corn), beans, and squash. At the southern tip of South America, the Indians lived in small bands that moved from place to place in search of food. They ate mainly fish and berries. These Indians spent so much time searching for food that they seldom built permanent shelters, made clothes, or developed tools.

The history of the New World includes the story of relations between the Indians and the European explorers, trappers, and settlers. Most of the Indians were friendly at first and taught the newcomers many things. The European explorers followed Indian trails to sources of water and deposits of copper, gold, silver, turquoise, and other minerals. The Indians taught them to make snowshoes and toboggans and to travel by canoe. Food was another of the Indians' important gifts. The Indians grew many foods that the newcomers had never heard of, such as avocados, corn, peanuts, peppers, pineapples, potatoes, squash, and tomatoes. They also introduced the whites to tobacco.

The Indians, in turn, learned much from the whites. The Europeans brought many goods that were new to the Indians. These goods included metal tools, guns, and liquor. The Europeans also brought cattle and horses, which were unknown to the Indians.

The Europeans and the Indians had widely different ways of life. Some Europeans tried to understand the Indians' ways and treated them fairly. But others cheated the Indians and took their land. When the Indians fought back, thousands of them were killed in battle. At first, they had only bows and arrows and spears, but the Europeans had guns. Even more Indians died from measles, smallpox, and other new diseases introduced by the whites.

As the Europeans moved westward across North America, they became a greater and greater threat to the Indian way of life. Finally, most of the remaining Indians were moved onto reservations. Today, most Indians in North America still do not completely follow the ways of white people. In some areas of Central and South America, several tribes have kept their language and way of life. But most of the tribes have become part of a new way of life that is both Indian and European.

Scholars called *anthropologists,* who study human culture, classify the hundreds of North and South American Indian tribes into groups of tribes with strong similarities. These groups are called *culture areas.* This article discusses Indians in terms of 15 culture areas. The culture areas of Canada and the United States are (1) the Arctic; (2) the Subarctic; (3) the Northeast, often called the Eastern Woodlands; (4) the Southeast; (5) the Plains; (6) the Northwest Coast; (7) California; (8) the Great Basin; (9) the Plateau; and (10) the Southwest. Those of Latin America are (1) Middle America, (2) the Caribbean, (3) the Andes, (4) the Tropical Forest, and (5) the South American Marginal Regions.

The first part of this article describes the family life and other activities of the North and South American Indians before Europeans came. Then the article tells how the Indians came to the New World and spread over the two continents. Next it describes the ways of life in the culture areas. The article then traces the destruction of Indian America and ends with a discussion of Native Americans today.

Family life

Most daily activities of an Indian family centered on providing the main necessities of life—food, clothing,

Article outline:

I. Family life
- A. Marriage
- B. Children
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- D. Food
- E. Clothing
- F. Shelter
- G. Hunting, gathering, and fishing
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IX. Peoples of the Arctic
X. Indians of the Subarctic
XI. Indians of the Northeast
XII. Indians of the Southeast
XIII. Indians of the Plains
XIV. Indians of the Northwest Coast
XV. Indians of California
XVI. Indians of the Great Basin
XVII. Indians of the Plateau
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XIX. Indians of Middle America
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XXI. Indians of the Andes
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XXIII. Indians of the Marginal Regions
XXIV. The destruction of Indian America
XXV. Indians in the early and mid-1900's
XXVI. Native Americans today

The contributors of this article are Donald L. Fixico, Professor of History at Western Michigan University; Alan L. Kolata, Professor of Anthropology at the University of Chicago; and Sharlotte Neely, Professor of Anthropology at Northern Kentucky University. All three are specialists in American Indian studies, and Professor Fixico is of Seminole, Creek, Shawnee, Sauk, and Fox descent.

and shelter. Some times of the year were busier than others. Among the salmon-fishing tribes of North America, for example, the spring and summer were the seasons for catching and storing fish. The winter was a relaxed time of year when many ceremonies and social gatherings were held.

Men and women usually had separate tasks. For example, both men and women were often involved in providing food. But they did so in different ways. In some areas, the women gathered wild plants for food, and the men hunted. In the Northeast and Southeast culture areas, the men hunted, and the women farmed the land. In parts of what are now Arizona and New Mexico and in Middle and South America, the men did the farming. The women gathered plants. In all areas, women were generally responsible for preparing the food.

Marriage. Many Indians married at an early age—the girls between 13 and 15 and the boys between 15 and 20. In some Indian tribes, the parents or other relatives chose the marriage partners for the young people. In other tribes, especially those of North America, a young man could select his own mate. He had to convince the girl and her parents that he would make a suitable husband. In many cases, he offered them valuable gifts to win their consent.

Throughout most of the New World, marriage was a family affair and not a religious ceremony. The boy's family usually gave presents to the bride's family. Many newly married couples lived with the girl's family—and the husband worked for her family—until the birth of a child. Then the couple might establish their own home. But they generally did not move to a new home in a new area. Many other newly married couples joined an existing family group or lived close to one. Some of the couples moved in with other relatives of the woman or with the relatives of the man. This *extended family* shared with the daily work of the household, including the raising of children.

Many Indian societies allowed men to have more than one wife. But this practice was common only among rich or powerful men. Certain tribes strictly limited men to one mate, such as the Iroquois and the Pueblo of North America.

After a man died, his wife would often live with his brother as husband and wife—even if the brother was already married. Similarly, if a woman died, her family would probably be expected to give her husband another unmarried daughter to replace her.

Children. Most Indian families were small because many children died at birth or as babies. But the youngsters usually had plenty of playmates. Many extended families included cousins, in addition to a child's own brothers and sisters.

Indian children were praised when they behaved well and shamed when they misbehaved. Only the Aztec and Inca tribes had regular schools. Boys and girls of other tribes learned to perform men's and women's jobs by helping their parents and older brothers and sisters. Games made Indian children skillful and strong.

After most boys reached their early teens, they went through a test of strength or bravery called an *initiation ceremony.* Many went without food for a long period or lived alone in the wilderness. In some tribes, a boy was expected to have a vision of the spirit that would become his lifelong guardian. Some groups also had initiation ceremonies for girls. A teen-ager who successfully completed an initiation ceremony was considered an adult and ready to be married.

Family groups. In many areas, a family group was even larger than an extended family. A *clan,* for example, consisted of a group of relatives who had a common ancestor. The members of a clan typically were related through either the men of the family or through the women, but not through both. Clan members were usually ready to help one another.

Another type of Indian group was the *association.* Associations resembled clans, but the members were not related. The tribes of the North American Plains had associations for men. Many of these groups were organized according to age classes. Youths joined a boys' association and then moved on to other associations at various stages in their lives. As adults, they could join warrior societies and other associations.

Sometimes tribes were divided into halves called *moieties* (pronounced *MOY uh teez).* Moieties often played each other in games. They also divided various tasks and responsibilities. For example, members of one moiety might help with the burial of members of another group and comfort them in time of mourning.

American Indians or *Native Americans*?

The native peoples of America were given the name *Indians* by the explorer Christopher Columbus, who thought he had reached a place called the Indies. At that time, each group of native peoples in the Americas had a name for itself. But the Indians did not have a name for themselves as a whole. Over time, the terms *American Indian* and *Indian* became widely used.

Today, several terms are used to refer to the native peoples of the Americas. They include *Indians, American Indians, Native Americans, Amerinds,* and *Amerindians.* There is no general agreement among Indians as to which term is preferred, though *Amerinds* and *Amerindians* are more widely used by scholars than by Indians themselves. Some Indians say that *Native Americans* is misleading because any person born in America is a native American.

The native peoples of Canada often use the terms *First Nations, aboriginals, first peoples,* and *indigenous peoples.* Most people of the Arctic prefer to be called *Inuit, Yuit,* or *Aleuts,* rather than *Eskimos.* The singular of *Inuit* is *Inuk.* Native Hawaiians are strongly opposed to being called *Native Americans.*

Many Indians prefer to identify themselves by tribal affiliation, such as Hopi and Cheyenne. However, many tribes acquired the names by which they are now known from other groups. For example, the Navajo received this name from the Spaniards, who called them the *Apaches de Navajó* to distinguish them from the Apache. *Navajo* was a Pueblo Indian word for an area of the Southwest. The Navajo, on the other hand, referred to themselves as *Diné,* which means "the people." Today, some members of this tribe are urging a return to the original name.

A Comanche Village by George Catlin; The Smithsonian Institution, Washington, D.C.

A village scene shows Comanche women curing buffalo hides. In the background, meat is drying in the sun. The Indians used buffalo skins for many purposes. They made clothes from them and stretched them over poles to form tepees. It took from 15 to 30 hides to make a tepee cover.

Food that Indians ate depended on where they lived. Indian tribes that lived on the plains of what are now the United States, where buffalo and other game were plentiful, ate mainly meat. Meat was also the principal food of those Indians who inhabited the woodlands and *tundra* (frigid treeless plain) of present-day Alaska and Canada. The Pueblo of the Southwest and other farming groups lived chiefly on beans, corn, and squash. Potatoes were an important crop among the Inca. Indians in the tropical areas of South America made bread from the roots of bitter cassava, a small shrub. Tribes that lived near water caught fish and gathered shellfish. Most Indian groups ate berries, nuts, roots, seeds, and wild plants. They also gathered salt and collected maple sap wherever they could.

Indians made a kind of tea from such plants as sassafras and wintergreen. Many Middle and South American Indians drank a mild beer that was known as *chicha*. They made this beer from corn, cassava, peanuts, or potatoes.

Indians who ate mostly meat cooked it by roasting, broiling, or boiling. Farming Indians and others who ate chiefly vegetables developed various methods of boiling or baking. They often made pit ovens by lining holes in the ground with hot stones. Indians preserved meat by smoking it or by drying it in the sun. North American Indians mixed dried meat with grease and berries to make a food called *pemmican*. Most Indians ate with their fingers, but some used spoons made from animal bones, shells, or wood.

Clothing. Many Indians made their clothes from animal skins and fur. Tanned deer hide, called *buckskin,* was one of the most common clothing materials throughout North America. Indians also used buffalo hides, rabbit fur, and bird feathers. Some tribes of the Northwest Coast of North America made cloth of bark and reeds, and the Pueblo wove cotton cloth. The Aztec, Inca, Maya, and some Caribbean tribes wove beautiful cotton and woolen cloth.

Indians of the South American tropics often wore no clothing at all. In many tribes, a man wore only a *breechcloth,* a narrow band of cloth that passed between the legs and looped over the front and rear of a belt. Women wore simple aprons or skirts. Indians in colder climates wore leggings, shirts, and robes. Some wore sandals or moccasins to protect their feet.

Shelter. Indians built many kinds of homes because they lived in different climates and had different building materials available to them. Those who moved about a great deal had simple shelters they could carry easily, or they built temporary shelters. Indians who stayed in one place built larger, more permanent homes. Some groups, such as the Haida of the Northwest Coast, built large houses where many families lived together. Others, including the Pomo of California, had simple dwellings that housed only a few people. In some cases, shelter changed with the season. Some Inuit of Canada built snowhouses during the winter. But in the summer, they lived in tents made of animal hides. In the United States, Inuit are sometimes called *Eskimos.*

Many Indians built a pole framework and covered it with leaves or bark, like the dome-shaped *wigwam* of the Northeast. The Iroquois followed a similar method in building their large, rectangular *long houses.* Some of these houses were more than 100 feet (30 meters) long. The Apache and Paiute used brush and matting to make simple *wickiups.* The Pawnee and some other North American tribes made *earth lodges.* They built their houses in pits and roofed the structures with sod. Poles or logs covered with earth formed the Navajo *hogan.* The Plains Indians built cone-shaped *tepees* of buffalo skins. In other areas, the Indians covered their tepees with animal skins or with tree bark. Indians at the southern tip of South America also used skins to cover

Text continued on page 141.

Where the Indians lived

The Indians of North and South America formed hundreds of tribes with many different ways of life. The location of many major tribes is shown here. Scholars divide the various tribes into groups of similar tribes that they call *culture areas*. Each culture area is shown in a different color.

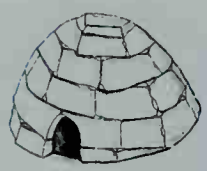
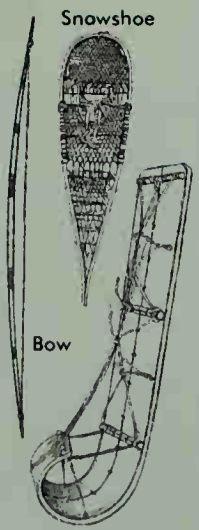
WORLD BOOK maps

How the Indians obtained food

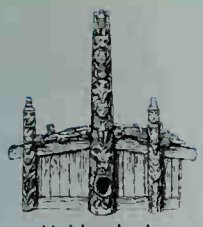
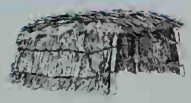
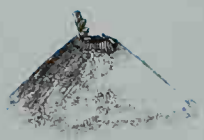
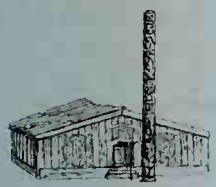
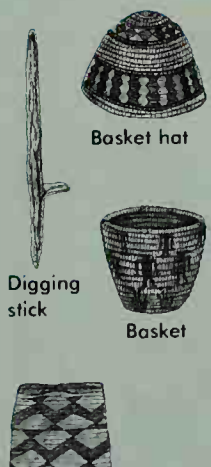
Most Indians hunted and fished for their food or gathered wild seeds, nuts, and roots. Farming was the main source of food only in the Southwest, Middle America, and the Andes. Many tribes of the Northeast and Tropical Forest areas also raised some crops.

Indian ways of life

The Indians had many ways of life. This chart shows some details of tribal life in the 15 major Indian culture areas. It pictures Indian clothing, buildings and shelters, and crafts and weapons.

	Arctic	Subarctic	Northeast	Southeast	Plains
Clothing	Mackenzie Inuit	Naskapi	Iroquois	Seminole	Sioux
Buildings ond shelters	Polar Inuit sealskin tent  Iglulik Inuit snowhouse	Cree bark tepee Cree bark lodge Chippewa domed bark lodge	Kickopoo wigwam Iroquois long house	Seminole house Creek house	Omaha earth lodge Wichita grass house Sioux buffalo-hide tepee
Crofts and weopons	Goggles Horpaan Birchbark basket	 Snowshoe Bow Toboggan	Birchbork container Corn mortar Wampum	War club Stickball racket River cane basket Woven basket Blowgun	Hide shield Honor feather Hide boat Sinew-backed bow Medicine pipe

WORLD BOOK illustrations by Carol Brozman; Richard Hook, Bernard Thornton Artists; and Anthony Saris

Northwest Coast	California	Great Basin	Plateau	Southwest
Tlingit	Hupa	Ute	Yakima	Hopi
 Haida plank house	 Tipai summer shelter	Paiute brush wickiup	 Flathead pit house	Pueblo adobe village
Manache bark house	Umotilla mat house	Navajo hogan		
 Kwakiutl plank house	Hupa plank house			Apache brush lodge
Wooden armor Wooden adz Copper knife Fishhook Salmon spear	Twined wicker seed beater Yew bow Rad armor Woven basket	Spoon Scoaplike seed beater War club Water basket	 Basket hat Digging stick Basket Buckskin bag	Grinding stones Pottery Throwing stick Gourd rattle Stick for planting corn

Indian ways of life

continued

WORLD BOOK illustrations by Anthony Saris

	Middle America	Caribbean	Andes	Tropical Forest	Marginal Regions
Clothing	Aztec	Carib	Inca	Yagua	Ona
Buildings and shelters	Maya ceremonial building; Maya thatch house	Guaymi hip-roofed house; Arawak thatch house	Inca masonry temple; Inca masonry and thatch house	Panoan house; Yamamadi communal house	Ashluslay shelter; Tehuelche dwelling; Yahgan hide and driftwood shelter
Crafts and weapons	Grinding stone; Pottery vessel; Sword (obsidian blades); Gold jewelry	Hammock; Gold nose clip; Shell ring; Maniac strainer; War club; Bow	Pottery vessel; Foot plow; Metal smelter; Quipu; Reed boat	Bow; Spear paint; Blow-gun; Paddle; Wooden drums	Bow; Bird snare; Coiled basket; Pipe; Bola

Detail of *Indian Hunters Pursuing the Buffalo* by Peter Rindisbacher; Peabody Museum of Archeology and Ethnology, Harvard University, Cambridge, Mass.

Snowshoes enabled the Indians to move swiftly on the surface of the snow. In the scene above, Assiniboine hunters close in on buffalo that have bogged down in the deep snow. Indians of the northern areas also used toboggans to move goods from place to place in winter.

shelters called *windbreaks,* which were open on one side. The cliff dwellers and other Pueblo Indians used *adobe* (sun-dried bricks) to make many-storied "apartment houses." Indians in Mexico and in the Andes Mountains of South America also used adobe.

Hunting, gathering, and fishing. Indians of the Arctic, Subarctic, Northwest Coast, and some other areas hunted or fished for most of their food. They also hunted some birds only for the feathers, and they prized the fur of beavers and certain other animals. Indians of California, the Great Basin, and the Plateau got most of their food by gathering wild seeds, nuts, and roots. Even in the Southwest and other farming areas, hunting, gathering, and fishing were important.

The most important game animals of North and South America included deer; rabbits and other small game; such birds as ducks, geese, and herons; such sea mammals as seals, sea lions, and whales; turtles; and snakes. Bear, buffalo, caribou, elk, and moose lived only in North America. Animals that were hunted mainly in South America included the guanaco, jaguar, peccary, rhea, and tapir.

Indians hunted with the same kinds of weapons they used in war. Many bows and arrows, spears, and clubs had special features for hunting. For example, some Indians used unsharpened arrows to shoot birds in trees. These arrows stunned the birds so that they fell to the ground. The Hopi stunned small game with a kind of boomerang.

The Indians caught fish with harpoons, hooks and lines, spears, and traps and nets. Tribes of the Northwest Coast also used long poles called *herring rakes.* These poles had jagged points and could catch a number of herring at one time. In tropical South America, Indians stood on river sand bars and shot fish with bows and arrows. Both North and South American Indians used drugs to catch fish. In one method, Indians chopped up certain plants and threw them in the water. These plants stunned the fish. Then the Indians could easily scoop them out of the water.

Farming by the Indians consisted mainly of growing corn, squash, and beans. Other crops included avocados, cacao, cassava, coca, cotton, guavas, peanuts, peppers, potatoes, tobacco, and tomatoes.

The farming tools of the tribes included pointed sticks for digging and hoes made of wood, stone, bone, or shell. Indians planted corn in small hills arranged in rows. Some tribes of eastern North America used dead fish to fertilize the soil. In the desert areas of the Southwest, the early Hohokam Indians dug long irrigation ditches to bring water to their crops. Irrigation was even more highly developed among the groups that lived in what is now Mexico and among the peoples who lived in the Andes Mountains. These Indians also cut hillside terraces to increase the amount of farmland by using mountain slopes.

Indians of the Northeast and the Tropical Forest used *slash-and-burn* farming methods. They cut down a num-

ber of trees and burned them. Then they planted their crops among the trunks. The ashes from the burned trees served as fertilizer.

Indians in the Caribbean area and in what are now Mexico and the Southern United States raised turkeys. Andean Indians kept llamas and alpacas for food and wool and also used them as beasts of burden. Dogs were the only other tame animals in North and South America.

Transportation. Before the arrival of the Europeans, the Indians lacked horses, oxen, and most other beasts of burden used in other parts of the world. As a result, the Indians never developed the wheel, though they had discovered its principle. The Inca and Maya built excellent roads, but most other tribes used narrow trails.

Travel by water was the most common means of transportation. Many Indians used bark canoes, which were light and easy to carry. Some large dugout canoes carried as many as 60 people. Indians also made light boats of reeds. Plains Indians stretched buffalo skins over a round frame to make a *bullboat.* Indians of the snowy north developed snowshoes and toboggans. Some favored groups, such as Inca nobles, traveled on wooden frames carried by servants.

Indians had few ways of carrying loads. The Plains tribes used dogs and, later, horses to pull a load-carrying frame called a *travois* (pronounced *truh VOY).* Andean Indians used alpacas and llamas as beasts of burden. But these animals could not carry heavy loads, so the people themselves carried most of their goods. People often supported a heavy load on their back with a pack strap called a *tumpline.* The strap was attached to both ends of the pack and stretched across the forehead.

Recreation. Almost all Indians played games. Men and women usually played separately and had different games. Children played almost all the games that their parents enjoyed.

Footracing was popular in many areas. The Indians of what are now northern Mexico and the Southwestern United States particularly enjoyed this sport and sometimes ran over a 30-mile (48-kilometer) course. Indians played many different kinds of ball games. In almost all these games, the players were not allowed to touch the ball with their hands. *Stickball* developed into the game of lacrosse. Usually, only women played *shinny,* or *shinty,* a kind of field hockey that was common in North America. The Aztec and Maya played a ceremonial game in which the players tried to bounce a large, hard rubber ball through a high vertical ring with their hips.

Winter Games of the Cheyenne by Dick West; Philbrook Art Center, Tulsa, Okla

Games of all kinds were popular with the Indians. Winter games included a stone-tossing game and "stick in the hoop," *foreground.* In the center, women play shinny and two men wrestle. Kickball, "snow snake" javelin throwing, and tobogganing are taking place in the background.

Scoring was so difficult that the game ended when either team scored. In some cases, the captain of the losing team was sacrificed to the gods.

In the *hoop-and-pole game,* the players rolled a hoop along the ground and threw spears or sticks at it. They scored according to where the spears hit. The Arapaho, for instance, cut four marks around the edge of the hoop. They tried to strike the rolling hoop so that the stick fell directly on or below a certain mark. Indians of the Southeast called this game *chunkey* and used a small stone ring as a target.

Many Indians enjoyed shooting arrows as a sport. They used several kinds of targets, including pieces of bark, woven grass, or an arrow stuck in a tree. Northern Indians enjoyed a game called *snow snake,* in which each player tried to slide a dart or spear farthest on snow or ice.

Quieter amusements included several games of chance. Guessing games were popular in North America. In the *hand game,* one or more players on a team held marked sticks in their closed fists. The players on the other side tried to guess where a certain stick was. The hiding side sang loudly to confuse the guessers, and both sides bet on the results.

Government

For the most part, the Indians of the Americas lived in small groups and shared in making important decisions. Some Indians, including the Aztec in Mexico and the Inca in Peru, developed complicated systems of government. But most tribes did not because they had no need for such systems.

Bands. Families of Indians joined together to form local groups called *bands.* These groups ranged in size from about 20 people to as many as 500. The size of a band resulted mainly from the number of people that the nearby area could support. If there was plenty of game or the land was rich, the band would probably be large. If food was scarce, the band would be small.

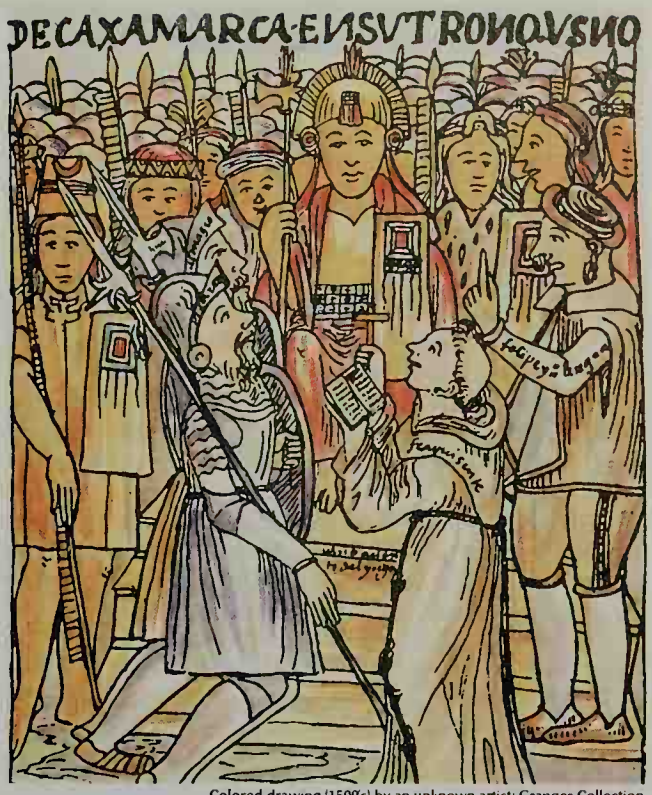
When faced with a problem, such as a shortage of food, the members of a band would gather around a fire to discuss it. They might offer prayers to their gods. In some areas, such a meeting was called a *powwow.* Some bands had permanent leaders, but others chose different leaders for different problems.

Tribes were larger than bands. Hundreds of tribes lived in the Americas when Columbus arrived. All the members of a tribe lived in the same general area. They spoke the same language and had the same religious beliefs.

Forms of tribal leadership varied. Tribes might have one or more leaders, often referred to as *chiefs.* In some tribes, one chief might be in charge of the tribe during peacetime. Another would lead the tribe in war. In some tribes, a person had to belong to a certain family, band, or clan to become a chief.

Although many tribes did not have a single permanent leader, certain groups called *chiefdoms* did. In both tribes and chiefdoms, decisions were typically made by general agreement after a meeting of the *tribal council.* This council consisted of members of the tribe who were respected for their wisdom or abilities.

Federations. Some Indian tribes in North America joined together to form groups called *federations.* The



Colored drawing (1500's) by an unknown artist; Granger Collection

A god-king ruled the vast Inca empire in the Andes Mountains. The picture above shows the Inca ruler Atahualpa, *center,* meeting with the Spanish conqueror Francisco Pizarro, *left.*

Oil painting on canvas (1832) by George Catlin, National Museum of American Art, Smithsonian Institution, Washington, D.C.

A Sioux chief wore an ornamental headdress and a fringed shirt to indicate his rank. Some Indian tribes were led by one chief in time of war and another chief during peacetime.

most famous federation was the Iroquois League, originally made up of the five Iroquois tribes—the Mohawk, Onondaga, Oneida, Seneca, and Cayuga. Historians believe that the Iroquois leader Hiawatha helped found the federation to stop the fighting among these neighboring tribes. Other federations, such as the Cherokee and Creek, were formed to fight common enemies or to solve various problems.

Empires and states existed only in Middle and South America. An emperor ruled the huge Aztec state in Mexico, and the people were divided into social classes. In the Inca empire, which stretched along the Andes Mountains in South America, a god-king ruled from $3\frac{1}{2}$ million to 7 million people. Among the Maya of Middle America, large cities ruled over the surrounding areas. Many of these cities were home to tens of thousands of people.

A formal state may have started to develop among the Natchez Indians and their neighbors in the Southeastern United States. The arrival of the Europeans halted its development. The Natchez had a powerful king.

Warfare

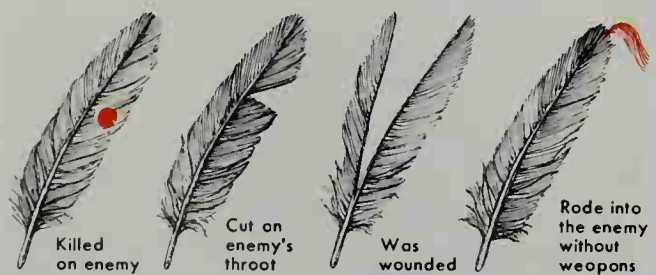
Wars occurred from time to time among the tribes of the Americas. But not all tribes took part in warfare. Many tribes opposed fighting, and others were so small that they did not have enough warriors to fight a war. Many of the Indian leaders who tried to defend their tribes and land against the advance of white people became famous warriors. They included King Philip, a Wampanoag; Pontiac, an Ottawa; Tecumseh, a Shawnee; Osceola, a Seminole; Crazy Horse, of the Oglala band of the Teton Sioux; and Geronimo, an Apache.

Weapons. The bow and arrow was probably the most common Indian weapon throughout North and South America. Some South American tribes put poison on their arrowheads. Many Indians fought with spears and war clubs. The Indians of eastern North America developed a special type of club known as the tomahawk. A weapon of the Aztec consisted of pieces of *obsidian* (volcanic glass) stuck into a wooden club. South American Indians used blowguns and slings.

Why the Indians fought. Warfare was sometimes the only way of settling disputes between tribes. A council, made up of the chiefs of tribes that had joined together, settled many arguments between tribes. But warfare might result if the council could not settle a dispute.

Warfare gave Indians a chance to achieve high rank in their tribes. On the Plains, it was considered braver to touch a live enemy and get away than to kill the enemy. This act was known as *counting coup* (pronounced *koo*). Warriors on the Plains carried a *coup stick* into battle and attempted to touch an enemy with it. Those warriors who counted coup wore eagle feathers as signs of their courage.

The scalp of an enemy was a war trophy in parts of North America. Some Europeans encouraged scalp hunting in North America by paying Indians who were friendly to the newcomers for the scalps of enemies.

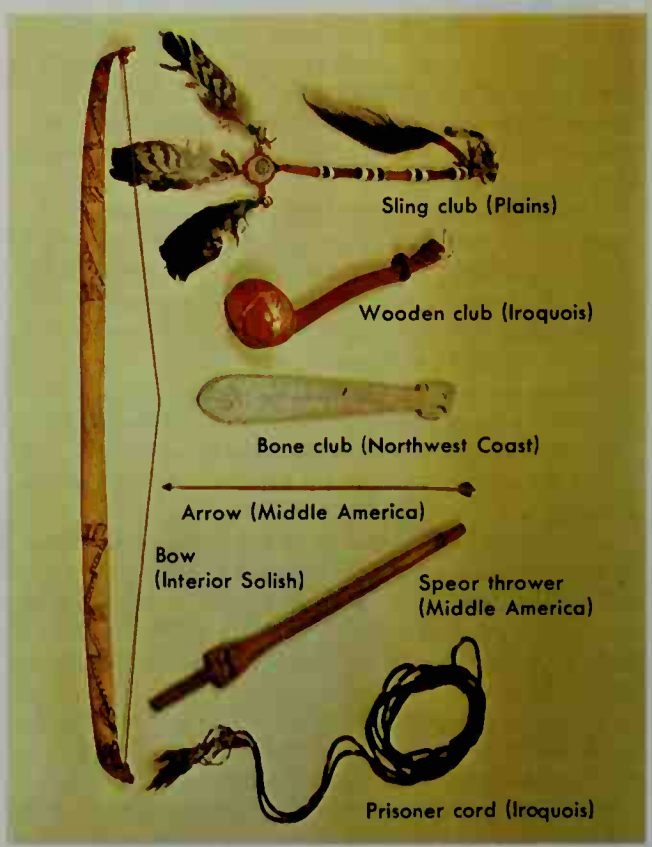


WORLD BOOK illustration by Anthony Saris

Honor feathers were awarded on the Plains for acts of bravery. Markings on the feathers identified the brave deed.

Field Museum of Natural History, Chicago (WORLD BOOK photo)

Shield covers were often decorated with symbolic designs. The buckskin cover, *above,* belonged to a Crow chief named Big Bear. The shield was made of thick, dried buffalo hide.



Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Weapons were made mostly of wood and bone. This bow from the Plateau area is 3 feet 8 inches (112 centimeters) long. The Iroquois club was an early form of tomahawk.

The Caribbean and Tropical Forest Indians fought for war honors and trophies that included skulls and shrunken heads as well as scalps.

The Aztec fought not only to enlarge their territory but also to take captives for sacrifice to the gods. Human sacrifice was a major part of the Aztec religion. Only the Aztec and the Inca had full-time armies. In other tribes, warriors went back to hunting or farming after their battles. Some tribes, particularly the Northwest tribes and the Iroquois, made slaves of their captives. The Witoto and Tupinamba tribes of the Tropical Forest tortured war captives and then ate them. But the victims were not eaten as a source of food. The Indians believed the dead person's strength and bravery would be passed on to the person who ate the flesh.

Warfare increased greatly in all areas after the Europeans came. It became the main way of settling disputes between the Indians and the whites. The Europeans adopted the Indian style of warfare—ambush, surprise attack, and quick withdrawal. The Indians began to use the Europeans' guns and other weapons.

Arts and crafts

Native Americans worked in many arts and crafts. For the most part, the Indians tried to make everyday objects attractive as well as useful. Indians also produced various forms of oral and written literature.

Pottery. The Indians created a great variety of beautiful pottery. They made most of their pottery by the coil method, in which pieces of clay are rolled into slender strips and laid on top of one another in spiral fashion. The Indian artist sometimes kept the coils on the pottery as decoration but often scraped the surface smooth.

Inca potters made some of the finest pottery in the New World. The Aztec and Maya painted some of their pottery with scenes of religious ceremonies. In North America, the early Indians of the Mississippi Valley made fine bowls and jars, many in the shape of animals.

Basketry. Almost all Indian groups made baskets that they used to store and carry food. The Indians also wove fibers into mats and wall coverings, articles of clothing such as hats and sandals, and fish traps. The Pomo Indians, who lived in California, were probably the finest basket makers in the New World. The Pomo sometimes decorated their baskets with shells, feathers, and beadwork. Pomo baskets were woven so tightly that they could hold water.

Carving. Middle American Indians created elaborate carvings. Large sculptures were used to decorate ancient Aztec and Maya structures or were placed alongside the structures as monuments. The Indians of Middle America also carved jade, onyx, quartz, and other materials. The Northwest Coast Indians made fine woodcarvings. Their ceremonial wooden masks had movable parts. They also carved house posts, grave markers, and totem poles.

Metalwork. The Andean people knew how to make bronze and how to cast, solder, and gild metals. The Caribbean Indians produced fine pieces of gold work. No such elaborate metalworking took place north of

Royal Ontario Museum, Toronto
(special photo for WORLD BOOK)

A ceremonial raven hat, over 4 feet (1.2 meters) long, was carved by craftworkers of the Northwest Coast.

Museum of the American Indian, New York City

Dyed porcupine quills were used by the Micmac Indians of the Northeast to decorate birchbark boxes and clothing.

Royal Ontario Museum, Toronto
(special photo for WORLD BOOK)

A pottery bowl was found at a Southwestern burial site. The hole was made to "kill" the vessel and free its spirit.

Royal Ontario Museum, Toronto
(special photo for WORLD BOOK)

Pomo basketry was among the finest in the New World. Feathers and beadwork were woven into this ceremonial basket.

University Museum, Philadelphia
(WORLD BOOK photo by Robert Crandall)

A deer's head uncovered in Florida is believed to date from about 1500. Leather hinges allowed the ears to move.

what is now Mexico. But Indians in the Lake Superior region and the Northwest Coast hammered copper to form tools and weapons. They also cut hammered copper into decorative or ritual objects.

Weaving was most common south of the Rio Grande. But the Pueblo of the Southwest wove cotton cloth before the arrival of the Europeans. The Navajo took up wool weaving later and became famous for their blankets and rugs. The Northwest Coast Indians made beautiful blankets of cedar fibers and mountain-goat hair. The Indians of the Southeast wove plant fibers so well that the early white settlers thought the material was actually cotton cloth.

Weaving was also an important art among the Inca. Their weaving of cotton and of alpaca, llama, and vicuña wool was so fine that it has not been improved upon—even with power looms.

Painting. The Indians usually combined painting with other arts. For example, much pottery of the Southwest Indians and of the Aztec, Maya, and Inca had painted designs. The Aztec and Maya also made large wallpaintings of important ceremonies and historic events. Painted designs also decorated some woodcarvings of the Northwest Coast tribes. The Pueblo were the first to make sand paintings, and the Navajo improved on this ceremonial art.

Literature. Most Indian groups handed down their folk tales and poetry by word of mouth for centuries. Some North American Indians, such as the Chippewa, recorded some of their tribal songs on bark. The Maya left behind manuscripts that tell of their ancient history. The Inca wrote dramas dealing with great military victories as well as with everyday life.

Religion

Indians had no one religion any more than they had one way of life or one language. But certain religious beliefs were widespread. Most important was the belief

An incense vessel from South America combines a llama and jaguar to create a decorative mythical beast.

Museum of the American Indian, New York City

Gold jewelry was made by the Caribbean Indians. The "lobster" pendant below is 4½ inches (11 centimeters) long.

Lee Boltin

Museum of the American Indian, New York City

Feather art was highly developed in the Tropical Forest. The headdress above was worn by a man of the Carajá tribe.

American Museum of Natural History, New York City

Maya sculpture was among the most elaborate in the New World. This clay figure shows an important nobleman.

National Institute of Anthropology and History, Mexico City

Mother-of-pearl mosaic, *above,* found at a Toltec site in Mexico, shows a human head inside an animal's jaws.

American Museum of Natural History, New York City

Beautiful Inca textiles were woven from cotton and from alpaca, llama, and vicuña wool. Mythical beings were often embroidered onto mantles, *above,* and then buried with important political and religious leaders.

Pine Tree Ceremonial Dance by José Rey Toledo; Museum of Art, University of Oklahoma, Norman

Religious ceremonies played an important part in the life of most Indian tribes. Many of these ceremonies were aimed at assuring a plentiful supply of food, and some lasted several days. The pine tree dance, *above,* was a harvest celebration of the Southwest Pueblo Indians.

in a mysterious force in nature. The Indians considered this unseen *spirit power* superior to human beings and capable of influencing their lives. People depended on it for success in the search for food and in healing the sick, as well as for victory in war.

Beliefs. Most Indians believed that the spirit power could be gained by certain people or through certain ceremonies. The power might be centered in some animals, areas, or things, making them powerful or dangerous. Some tribes had a name for the spirit power. The Iroquois called it *orenda,* and the Sioux referred to it as *wakonda.*

Some tribes believed in a *great spirit*—an especially powerful god. But the great god belief was always accompanied by a belief in many other spirits or in the general spirit power.

The peoples of Middle America and the Andes had whole families of gods. The Aztec, for example, worshiped hundreds of gods. The Inca believed that their ruler was also a god—a god-king—and they worshiped him along with their other gods.

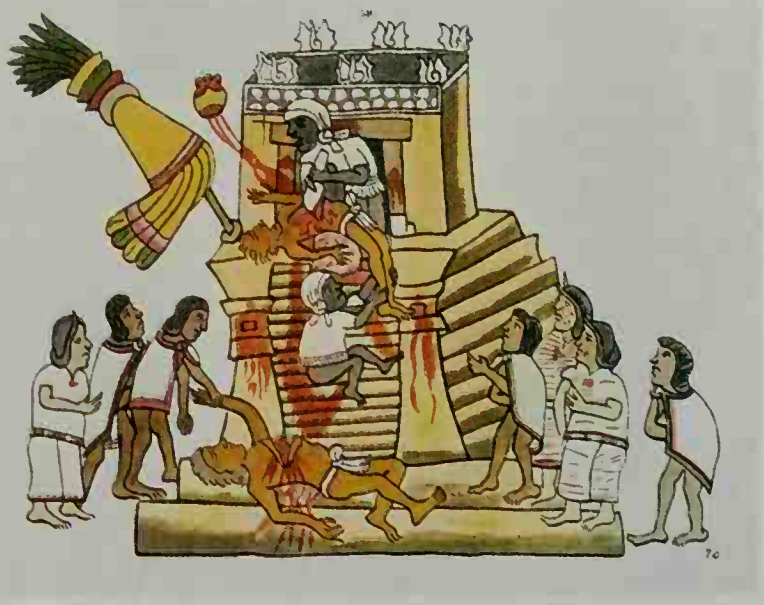
The Indians in some areas greatly feared the ghosts of the dead. But few Indians gave much thought to life after death or the idea of a heaven.

The guardian spirit. One way of reaching the powerful spirit world was through a personal spiritual helper called a *guardian spirit.* The Indians believed that the spirit helped guide a person through the hardships of life. An individual might have one special guardian spirit, or different ones for different needs. Belief in a guardian spirit was common throughout most of the New World.

When boys—and, in some tribes, girls—reached their early teens, they went through an initiation ceremony to help them find a guardian spirit. Many went without food, sleep, or companionship until they saw a vision of their guardian spirit. Some wounded themselves to help bring a vision. This search for a vision of a guardian spirit is known as a *vision quest.*

Shamans. The spirit world could also be reached with the aid of a religious helper called a *shaman.* The shaman was believed to have close contact with the spirit world. Shamans were sometimes called *medicine men* or *medicine women* because their tasks included treating the sick.

Some Indians believed that certain diseases were caused by an object in the body. Shamans began their cure for such conditions with special songs and movements. They usually blew tobacco smoke over the sick person because tobacco was believed to have magical powers. Shamans sucked on the body of the sick person until they "found" the object causing the illness. Then



Drawing of Aztec sacrifice from *Codex Magliabecchi;* The Newberry Library, Chicago

The Aztec Indians of Middle America sacrificed prisoners to many gods. Religion controlled every part of Aztec life, and the priests were important members of the community.

they spit out the object—usually a small stick or a stone that they had hidden in the mouth.

Shamans had some knowledge of medicine. They set broken bones and used various herb remedies. Many plants they used are still given by doctors today. Curare arrow poison is used in treating hydrophobia and tetanus. The Indians also used quinine, which physicians prescribe to treat malaria. The Inca developed *trephining,* the removal of part of the skull. This surgery was often used to relieve pressure on the brain.

Occasionally, shamans joined together to form a religious organization called a *curing society.* Such organizations included the Midewiwin Society of the Chippewa and the False Face Society of the Iroquois.

Priests performed public ceremonies for an entire Indian group, but a shaman usually helped only a single person or family. Unlike shamans, priests went through long periods of formal training. They also used more equipment than the shamans and had places of worship for performing ceremonies. Indian groups with priests included those of the Northeast, the Southeast, the Southwest, and Middle and South America.

Prophets. A new type of religious leader appeared among the Indians after the Europeans arrived. Most of the new leaders urged their followers to give up European goods—especially liquor—and return to the old ways of the Indians. Because these leaders predicted future events, the Europeans called them *prophets.*

Sometimes the prophets preached war to the death against the whites. But often they called on the Indians to live separate, peaceful lives. Famous Indian prophets included Hiawatha, the Iroquois leader who helped form the Iroquois League in an effort to end wars between tribes; Popé, a leader of the Pueblo revolt of 1680; and the Shawnee Prophet, a brother of Tecumseh. Handsome Lake, an Iroquois prophet, founded the Long House religion, which combined elements of Christianity and traditional Iroquois religion. Wovoka, a Paiute, founded the Ghost Dance religion of 1890, which taught that the great spirit would restore the Indian world to the way it was before whites arrived.

Ceremonies. Native Americans held a number of kinds of ceremonies. Many of these rituals were designed to ensure that the Indians had enough food. Hunting tribes performed ceremonies to keep game plentiful. The Plains Indians, for example, believed that the buffalo dance would ensure success in hunting buffalo. Farming tribes held planting ceremonies, rain dances, and harvest festivals. The green corn dance of the Indians of the Southeast celebrated the summer's first corn crop. At the end of the Hopi snake dance, snakes were released to ask the rain god to send rain.

The Pueblo people had religious societies that performed dances the year around to ensure good crops. One such group was the Kachina Society of masked dancers. These dancers also visited the homes of children to ask if the youngsters had been good. If they had not, the Kachina dancers might punish them.

The sun dance was the chief ceremony of the Plains Indians. The Indians performed it to gain supernatural power or to fulfill a vow made to a divine spirit in return for special aid. Some men tortured themselves as part of this ceremony. A sun dance lasted several days.

Nearly all Indian tribes of North and Middle America had some kind of a *sweat lodge ceremony.* This ceremony took place in a building called a *sweat lodge.* Some sweat lodges were heated directly by a fire. But in many lodges, water was poured over heated stones to produce steam. The hot steam caused occupants of the sweat lodge to perspire. Sweat lodge ceremonies were designed to purify the body, cure illnesses, and influence spirits.

The most elaborate ceremonies were those of the Aztec and Maya in Middle America and the Inca in the Andes Mountains. Priests directed these great public celebrations. Some lasted for several days. Major Aztec ceremonies included human sacrifices to the gods.

Music accompanied most Indian ceremonies. Many tribes sang to the rhythm of rattles, clappers, and drums. Some tribes also used flutes and whistles. Panpipes, a series of hollow reeds tied together, were common in the Caribbean region and in South America.

Legends of gods, spirits, and ancestors were handed down from parent to child. Legends formed the basis of various ceremonies. Indian legends included stories of the world before it had people, stories of the origin of people and tribes, and tales of tribal heroes.

Trade

Trading was an important Indian activity. The Indians learned much from one another as they exchanged goods and shared ideas and experiences. Throughout the Americas, goods were traded along routes that existed thousands of years before the Europeans arrived.

In North America, obsidian was carried from the Rocky and Cascade mountains, flint from Ohio and southern Canada, copper from Lake Superior, mica from North Carolina, and shells from the Gulf of Mexico and the Atlantic and Pacific coasts. In both North and South America, Indians traded tobacco wherever it could not be grown. Salt was widely traded in agricultural areas.

Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Tooth shells were used much as money by the Indians of the Northwest Coast. Each string of shells had a fixed value that was determined by the size of the shells and the length of the string.

Codex Florentino, Laurentian Library, Florence, Italy; (American Museum of Natural History, New York City)

Aztec merchants traveled over a large area of Middle America. The trader in the Aztec drawing above offers gold, copper, obsidian, and cloth in exchange for tropical products.

Detail from *Indians Bartering* by Coke Smyth; Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Trade in North America increased after the arrival of the Europeans. The Indians traded animal furs and other items for such goods as cloth, guns, liquor, and metal tools.

In Middle and South America, precious metals and gems were important items of trade.

Money. The Indians had no formal system of money. For the most part, they traded goods and services for other goods or services. In some areas, the Indians used certain objects much as money is used today. Among the Indians of California and the Northwest Coast, sea shells called *dentalia* or *tooth shells* were divided into five sizes. The longer the shell, the greater was its value. Indians of Middle America used cacao beans, from which chocolate is made, as money.

In eastern North America, Indians sometimes used *wampum*. Wampum, a combination of purple and white beads made from shells, was strung into necklaces or belts. It served mainly as a means of keeping records or recording treaties. But because it had value, it was also used as money.

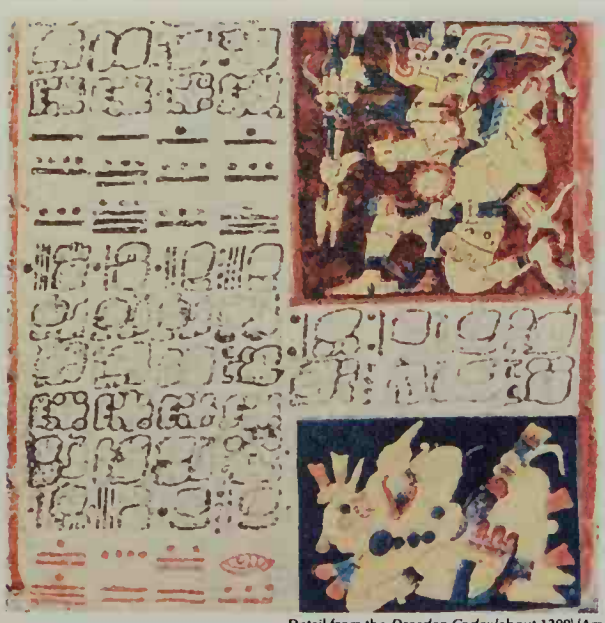
Trading centers for various products existed only in parts of Middle and South America. These public markets had full-time traders and merchants. Among the Aztec, traders also served as spies for the government. Many lived among conquered tribes and watched for signs of revolt or nonpayment of *tribute* (required goods) to the Aztec.

Trade between Indians and whites was important in North America. The settlers needed many of the things the Indians had, and the Indians wanted guns, horses, liquor, and metal tools. Both groups used beaver pelts and buffalo hides as items of trade in the northern areas and on the Plains.

Language

Many scholars believe the Indians of North and South America spoke more than 2,000 languages at the time the Europeans arrived. At least 300 separate languages were spoken north of Mexico. Some had many similar words and grammar, but others differed greatly. Many Indian languages are lost because all the people who spoke them died before their languages could be recorded.

Language groups. Native American languages, like other languages, can be classified in large groups. In general, languages are grouped into *families*, which in



Detail from the *Dresden Codex* (about 1200) (American Philosophical Society)

Maya writing used dots and dashes for numbers and had symbols called *glyphs* for words. Some glyphs stood for ideas and some for sounds. This Maya book is made of bark paper.

Museum of the American Indian, New York City

Symbols painted on animal skins recorded the passage of time in parts of North America. Each symbol stood for an important event in the life of the tribe for a given year.

turn are grouped into larger language *phyla*. One classification of Indian languages has 11 main phyla. These phyla are (1) American Arctic-Paleosiberian, which includes the languages of the Eskimo-Aleut family; (2) Andean Equatorial; (3) Aztec-Tanoan, which includes the Uto-Aztecan family; (4) Gê-Pano-Carib; (5) Hokan; (6) Macro-Algonquian, which includes the languages of the Algonquian and Muskogean families; (7) Macro-Chibchan; (8) Macro-Otomanguean; (9) Macro-Siouan, which includes the Iroquoian and Sioux families; (10) Na-Dene which includes the languages of the Athabaskan family; and (11) Penutian.

Sometimes one language became the *trade language* for many tribes. For example, a waterfall at The Dalles on the Columbia River was an important trading site. The Chinook Indians of the area spoke for the various tribes who came there to trade. As a result, the Chinook language became a trade language. After European contact, mixtures of European and Indian languages began to be used for trading.

Writing. The most highly developed Indian writing systems included those of the Maya, the Aztec, and some of their neighbors in Middle America. Maya writing consisted of symbols called *glyphs,* which were carved in stone. The Maya also wrote on bark paper and deer hide. Scholars have translated about half the known glyphs. The Maya had a number system based on 20, and a symbol for zero. They used their numbers to create a calendar that may have been more accurate than those of the ancient Egyptians, Greeks, or Romans.

Aztec writing consisted of *pictographs,* most of which were pictures of objects. The Aztec used pictographs mainly to keep records. The Spaniards learned to read Aztec writing, which was still in use when they arrived. But Maya writing had not been used for several hundred years before the Europeans came.

The Inca kept records by tying knots on a string called a *quipu.* The quipu used the decimal system. The knots at the end each stood for 1, those farther up each counted for 10, and those still higher up stood for 100. The Inca recorded crop records and population information by this method.

Some tribes used pictures or wampum to keep records. Pictures drawn on animal skins or bark showed events in a person's life or a tribe's history. The drawings also recorded the passage of time. Belts of wampum kept account of treaties.

In North America, a Cherokee named Sequoyah in-

Native Americans and the English language

When European explorers and settlers came to the New World, they adopted many Native American words for animals and plants not found in the Old World. Eventually, many of these words became part of the English language. Animal names that come from Indian words include *moose, opossum, raccoon, skunk,* and *woodchuck.* Among the plant names based on Indian words are *hickory, hominy, pecan, pone, squash,* and *succotash.*

Other English words borrowed from Indian languages include *moccasin* and *toboggan.* In addition, *avocado, canoe, chili, chocolate, coyote, hurricane, tobacco, tomato,* and many other words come from Spanish versions of Indian words.

Hundreds of mountains, rivers, cities, and towns in North and South America also have Indian names. For example, the name of the Mississippi River comes from an Algonquian word meaning "big river." Such cities as Chicago, Milwaukee, Omaha, and Ottawa have Indian names. So do more than half the states of the United States, including Alabama, Connecticut, Illinois, Iowa, Kansas, Utah, and Wyoming. The names of the Canadian provinces of Manitoba, Ontario, Quebec, and Saskatchewan have Indian origins as well.

vented a writing system called a *syllabary*. This system consisted of symbols that stood for sounds in the Cherokee language. With 86 signs, he could write any Cherokee word. See Sequoyah (picture).

Other communication. The Indian tribes of the Plains spoke many languages and needed some means of communicating with one another. From this need came a series of commonly understood gestures called *sign language*. After the Indians obtained horses, many more tribes came together on the Plains. This situation led to the further development of sign language. Sign language was not a complete language, and it could not express any complicated idea. Nor was it understood by Indians outside the Plains region. For an illustration of sign language, see the *Indians of the Plains* section of this article.

Indians also used smoke signals and drum signals. However, these forms of communication could send only limited information—a warning, for example.

The first Americans

The story of the American Indians began thousands of years ago. Scholars know little about these first Americans. Scientists have had to dig their story out of the earth itself. Pottery, stone tools, bones of human beings and animals, charcoal of campfires—all these have offered clues about how and when the early Indians lived. But many questions remain unanswered.

Scientists believe that American Indians are descended from the peoples of eastern Asia. In some ways, Indians resemble the Chinese, Japanese, and other peoples of eastern Asia in appearance. For example, they have straight black hair and high cheekbones, and little hair on their bodies. But Native Americans also differ from their Asian relatives as well.

Early days. For a long time, no people lived in the Americas, though many animals roamed the land. They included huge mammoths and mastodons, herds of bison and elk, and saber-toothed cats.

During the Pleistocene Epoch—between about 2 million and 11,500 years ago—great sheets of ice covered much of the Northern Hemisphere. These ice sheets were up to about 10,000 feet (3,000 meters) deep. The level of the oceans became lower because so much of the earth's water made up the ice sheets. Much land that had been under water—and is under water again today—became dry. One such area lay between Siberia and Alaska, where the Bering Strait now separates Asia and North America by about 50 miles (80 kilometers).

Plants started to grow on the new land, and animals began to cross it in both directions, grazing on the vegetation. Some people of Siberia followed the animals that they hunted, and they crossed this land into the New World. These people were the ancestors of the American Indians. No one knows exactly when these people came to North America, but most experts believe they arrived at least 15,000 years ago. By about 11,500 years ago, the ice sheets had melted and the land bridge became covered with water. By 6000 B.C., people were living at the southern tip of South America.

The first Americans lived in small bands of 20 to 50 people. They followed herds of the animals they hunted and never settled anywhere for long. Their shelters were probably crude and temporary.

The weapons of the early Indians were mainly wooden spears with sharp stone points. Some of the points had a large flake removed from one or both sides. This type of point is called a *fluted* point. The first fluted point was discovered in the early 1900's among a pile of animal bones near Folsom, New Mexico. Fluted points of that type are called Folsom points. Early Indians also used a spear-throwing device called an *atlatl,* which increased the range and force of their spears.

The animals hunted by the early Indians were very large. The hunters often found it easier to kill these beasts by driving them into swamps or over cliffs, rather than spearing them. Most of the knowledge that we have about the hunters comes from these sites where animals were killed.

The changing land. Slowly the climate turned warmer and wetter, and the huge ice sheets began to melt. Water from the ice sheets flowed into riverbeds

Early Indian artifacts

Much of what we know about the early Indians has been dug out of the earth by archaeologists. Pottery, stone tools, and the bones of people and animals give clues to how these people lived.

University of Nebraska, Lincoln

Spear points have been found with animal bones. The Folsom point above is about 8,000 years old.

Museum of the American Indian, New York City

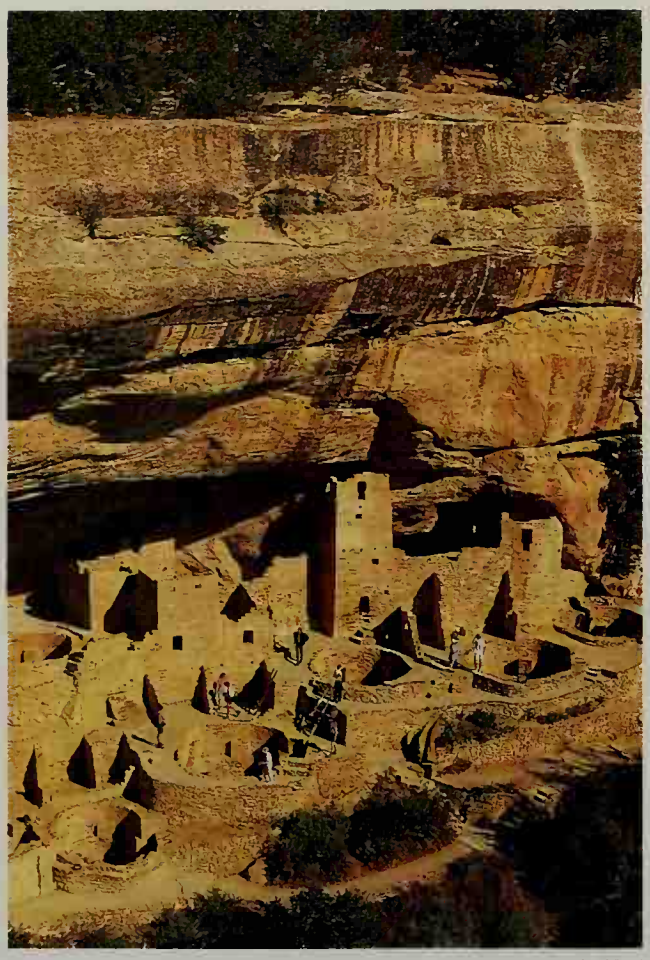
A mountain sheep made of volcanic ash was uncovered in Arizona. It was probably made by Hohokam Indians about A.D. 800.

Museum of the American Indian, New York City

Deer masks carved from cedar had pieces of shell for the eyes and mouth. This mask was found in Oklahoma.

Museum of the American Indian, New York City

A shell disk shows a man in ceremonial dress. It was carved by an early mound-building Indian in Tennessee.



Joe Viesti

Cliff dwellings of the Anasazi Indians were built in canyon walls of the Southwest mainly from about A.D. 1000 to 1300. The Anasazi hunted and grew corn, beans, cotton, and other crops.

and lakes, and raised the level of the oceans. The land across the Bering Strait became covered with water, and migration to the New World all but stopped.

The large animals hunted by the early Indians began to die out about this time. No one knows exactly why, but the animals' food supply of grass may have slowly decreased as the climate changed.

A change in Indian ways of life accompanied the changing climate and plant and animal life. In North America, great forests replaced many grasslands in the north and east. Small, swift animals lived in these woodlands. The Indians may have begun to use the bow and arrow at this time. It made a good weapon for hunting the swift woodland animals. Around the lakes and along the rivers, the Indians began to fish and to trap ducks and other water birds. They gathered shellfish for food along the coasts of both North and South America.

Some regions became desertlike. The Indians who lived in these areas ate more plant food because the animals were small and scarce. The desert people ground seeds to make flour, gathered berries and bulbs, and ate nuts. Sometimes they added meat to their diet—chiefly rabbits, prairie dogs, and an occasional deer.

The first farmers. In what is now Mexico, the warm, dry climate produced a way of life similar to that of other desert areas—with one important difference. The people began to cultivate certain grasses that became the ancestors of modern corn. By 1500 B.C., the Mexican Indians had improved the quality of corn until it grew as large ears. Corn, along with beans and squash, became their main source of food. These Indians no longer had to travel in search of food, and they began to settle in villages. With farming, the land could support more people. They could build more permanent houses and towns, and have more time for arts and crafts and religious ceremonies. Monte Albán, Teotihuacán (pronounced *tay oh TEE wah KAHN*), and other large cities developed.

Farming spread both north and south from Mexico. In Middle America and the Andean Highlands, the Aztec, Maya, and Inca achieved the most complicated societies in the New World. As the North American Indians learned farming, their villages grew larger. Farming along the Ohio and Mississippi rivers became so productive that villages developed into towns and cities. Between about 100 B.C. and A.D. 500, in Ohio, the Hopewell Indians built huge burial mounds and ceremonial centers. Along the Mississippi and other major rivers, from about 700 to 1700, some cities grew to great size.

Estimates of the Indian population of the New World when Columbus arrived vary. Many scholars estimate that there may have been between about 30 million and 75 million Indians living in all of North and South America, with about 2 million to 7 million of these Indians living in North America north of Mexico. But some estimates run as high as 118 million for the Americas, with about 18 million living north of Mexico.

Peoples of the Arctic

In North America, the Arctic includes most of the seacoast of Greenland, northern Canada, and Alaska. The land consists mainly of tundra. In the winter, ice and snow cover the ground, and most of the Arctic Ocean is covered with ice.

Scholars classify the native peoples of the Arctic into three large groups: (1) the Aleuts, who live on the Aleutian Islands off the coast of mainland Alaska; (2) the Inuit, who live from northern Alaska across Canada to Greenland; and (3) the Yuit, who live in western and southern Alaska and in Siberia, in Russia. The three groups have similar ways of life, but their languages, though related, differ.

Arctic peoples probably began to migrate across the Bering Strait into the New World about 10,000 years ago. They were the last Native Americans to arrive in the Western Hemisphere. They are more closely related to

The Arctic area

Major groups:

Aivilik Inuit
Aleut
Baffinland Inuit
Bering Strait Yuit
Caribou Inuit
Copper Inuit
East Greenland Inuit
Iglulik Inuit
Labrador Inuit
Mackenzie Inuit
Netsilik Inuit
North Alaskan Inuit
Pacific Yuit
Polar Inuit
Southwest Alaskan Yuit
West Greenland Inuit

Colored engraving (1800's) by an unknown artist; Granger Collection

An Inuk man, dressed in snowshoes and a warm coat, prepares to go hunting with his dog. The Inuit and other Arctic peoples obtained food mainly by hunting and fishing.

peoples who currently live in Siberia than they are to many other native peoples of the Americas. As a result, many scholars do not refer to the Inuit, Aleuts, and Yuit as Indians.

Before European contact. Most Arctic peoples lived in small bands, mainly in widely scattered settlements along the seacoast. The bands moved often in search of food but usually remained within a certain territory. Most Inuit bands did not have permanent leaders. Many Aleut and Yuit villages had chiefs.

Arctic peoples obtained food mainly by hunting and fishing. Seals were the primary food across most of the region. Sealskin was widely used for making shelters and boats, clothes, tools, and other goods. Arctic peoples also hunted a type of deer called *caribou* and whales, walruses, and other sea mammals for their skin and for food. In much of the Arctic, meat was eaten raw because there was no firewood.

Men, women, and children of the Arctic wore similar clothing. They usually wore a caribou-skin *parka* (hooded jacket) and trousers and sealskin boots. Babies and young children often rode in their mothers' hoods.

In Alaska and Greenland, many shelters were made of wood, sod, stone, or animal skins. In much of Alaska, forests provided wood for making permanent houses. Some Inuit in Canada built snowhouses during the winter, but they lived in skin tents during the summer.

The Inuit used skin boats for travel and to hunt sea mammals. These boats were made of sealskin or walrus skin stretched over a wooden frame. In the winter, Arctic peoples often traveled across the frozen sea and the frigid land on dog sleds.

Weapons of the Arctic peoples included harpoons, spears, bows and arrows, and knives. Bones and antlers were often used to make arrowheads and spear points.

Arctic peoples believed the animals, mountains, sea, and other things around them each had a spirit. Shamans were thought to have some control over the spirit world. When hunters killed an animal for food, they thanked its spirit.

After European contact. The Inuit in Greenland came into contact with Vikings about 1,000 years ago. Beginning in the 1500's, European explorers met the Inuit of northeastern North America. Aleuts and the Yuit of Alaska first met Russian and other European explorers, traders, and colonists in the 1700's.

Contact between whites and Arctic peoples increased during the 1800's as whaling and the fur trade grew in the region. Rifles obtained from the whites enabled the Arctic peoples to hunt more efficiently but also eventually led to a scarcity of game animals. Today, the peoples of the Arctic have adapted to the modern world while preserving much of their traditional way of life.

For more information on the peoples of the Arctic, see **Aleuts** and **Inuit.**

Indians of the Subarctic

The Subarctic is a large semiarctic region that includes the interior of Alaska and most of Canada. It is a land of cold winters and heavy snows. The Subarctic has many lakes and streams, and forests of fir, pine, spruce, and other evergreen trees.

Before European contact. The Subarctic was one of the most thinly populated regions of North America. The Indians who lived in this rugged region belonged to one of two major language groups—the Algonquian speakers in the east and the Athabaskan speakers in the west. In spite of their language differences, the two groups had similar ways of life.

Subarctic Indians lived in much the same way as did the first peoples to migrate from Asia to the New World. Tribes consisted of many small bands. Each band lived in its own territory but was related through marriage to other bands in the tribe. Many Indians in the east traced family ties through the father. Subarctic Indians in the west generally traced ancestry through the mother. Most tribes did not have permanent leaders.

The Subarctic area

Major groups:

Beaver	Kaska
Carrier	Koyukon
Chilcotin	Kutchin
Chipewyan	*Montagnais
*Chippewa (Northern Ojibwa)	*Naskapi
	Sarcee
	Sekani
*Cree	Slavey
Dogrib	Tanaina
Han	Tutchone
Hare	Yellowknife
Ingalik	

*Has a separate article in *World Book.*

Detail of *Encampment Among the Islands of Lake Huron* (about 1845-1850), an oil painting on canvas by Paul Kane; Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Bands of Indians hunted and fished along the Subarctic's many lakes and rivers during the summer. They lived in tepees and moved from one camp to another in canoes. During the winter, they lived in sturdier bark lodges.

Food was often scarce, and the Indians moved about hunting and gathering wild plants, berries, and nuts. The growing season was too short for farming. Buffalo, caribou, deer, elk, moose, and musk ox were the main animals hunted. Fish and shellfish were important foods along the coasts, rivers, and lakes of the region.

Indians of the Subarctic made most of their utensils of wood. They made containers but no pottery. In the east, containers were fashioned from bark, and in the west they were made of woven spruce roots.

Subarctic tribes used caribou or moose skin to make most of their clothing. The men wore long shirts, breechcloths, leggings, and moccasins. The women had about the same clothing but wore longer shirts and shorter leggings. In winter, everyone wore robes, mittens, and fur caps for extra warmth. The Indians decorated many of their garments with quillwork, embroidery, or painted designs.

Houses were made of wooden frames covered with bark, brush, or animal skins. The Indians also built dome-shaped wigwams, lean-tos, and sturdy log houses. Families that moved around a lot lived in tepees.

In summer, the Indians of the Subarctic used bark canoes to travel on the lakes, rivers, and streams in search of food. In winter, they used wooden toboggans and snowshoes for travel.

Weapons of the Subarctic included bows and arrows, spears, clubs, and knives. In the east, the tribes used stone to make arrow points and knife blades. The western tribes generally used bone and antlers to make tools, and beaver teeth for making knives. Wars were almost unknown.

After European contact. The Indians usually had good relations with the early French fur traders. But the tribes slowly changed their way of life by hunting fur-bearing animals that they traded to the French for weapons, traps, and food. Previously, they had made most of the necessities of life from various parts of the animals they killed.

The Indians took sides in the wars between the French and English colonies. Some fought for the French and some for the English. The tribes also fought one another as a result of competition for the fur trade. Eventually, the Indians lost their land to the settlers. Today, most Subarctic Indians live in areas set aside for them, called *reserves* in Canada and *reservations* in the United States.

Indians of the Northeast

The Northeast culture area extends from just north of the Canadian border to just south of the Ohio River. It stretches from the Atlantic Ocean, including the coasts of Virginia and northern North Carolina, to about the Mississippi River. The Northeast is a region of cold winters and warm summers. Forests cover much of the area, which is often called the Eastern Woodlands. Rolling prairies lie in the west.

Before European contact. Almost all the Northeast tribes spoke an Iroquoian or Algonquian language. The Iroquoian-speaking tribes included the Cayuga, Mohawk, Oneida, Onondaga, and Seneca. By the early 1600's, these five groups had joined together to form the Iroquois League. The Tuscarora joined the league in the

The Northeast area

Major groups:

Abenaki
*Algonquin
*Beothuk
*Chippewa (Ojibwa)
*Delaware (Lenape):
*Munsee
Unalachtigo
Unami
Erie
Fox (Mesquakie)
Huron
*Illinois
*Iroquois:
*Cayuga
*Mohawk
Oneida
Onondaga
*Seneca
*Kickapoo
*Mahican
Maliseet
Massachusett
*Menominee
*Miami
*Micmac
*Mohegan
Nanticoke
*Narragansett
Neutral
Ottawa
Pequot
*Potawatomi
*Powhatan
*Sauk
*Shawnee
Susquehannock
Tuscarora
Wampanoag
*Winnebago

*Has a separate article in *World Book*.

early 1720's. The Huron also spoke an Iroquoian language, but they were enemies of the league.

The Iroquois lived mostly by growing corn, beans, and squash. Slash-and-burn agriculture was the main method of farming. The women farmed and gathered wild plants, nuts, and berries. Men hunted and fished.

Among the speakers of Algonquian languages were the Abenaki in the east and the Chippewa in the west. Some of the northernmost groups depended more on hunting, gathering, and fishing than on farming. But most Algonquian groups grew corn, beans, squash, and other crops. The Chippewa and other Indians of the Great Lakes region also harvested wild rice. Some tribes collected the sap of maple trees.

Houses were made to protect people from the cold in winter. Most Northeastern Indians lived in villages of dome-shaped wigwams covered with bark. Iroquois villages included long houses with separate sections for related families. Tall fences called *palisades* surrounded many villages and provided protection from enemies.

The Indians of the Eastern Woodlands traveled on foot or in bark canoes. Northeastern Indians made deerskin shirts, dresses, leggings, and breechcloths. Many of these Indians rubbed their hair with bear grease to make it smooth and shiny. In some groups, men shaved their heads almost completely, leaving only a small tuft of hair on top.

Warfare sometimes broke out among Northeastern Indians. Weapons included clubs and bows and arrows. The Iroquois were the dominant group in warfare.

Family ties were traced through the father among most Algonquian speakers. Among the Iroquoian speakers and a few Algonquian speakers, however, family ties were traced through the mother. Many Iroquois long houses sheltered an elderly couple with separate "apartments" for each married daughter. The couple's married sons lived in the long houses of their wives' families.

Leaders of the Eastern Woodlands tribes were called *sachems*. The five tribes that formed the Iroquois League chose 50 sachems to lead their federation. The sachems were chosen from different clans. Only men could be sachems, but only women had the right to select who became a sachem. If a sachem did not do what the women wanted in council, they could remove him and select a new leader.

When councils of the Iroquois League met, they made decisions by consensus. Sachems would give speeches setting forth their position on an issue. Discussions sometimes went on for hours or days until everyone could compromise and agree on the same plan.

Religion played an important part in the lives of the Indians of the Northeast. These tribes believed in a spirit power that inhabited many creatures and forces of nature and could appear in visions as guardian spirits. In some Alonquian languages, this power was called *manito*. Shamans supposedly could summon helper spirits to cure diseases or to predict who would win a war.

Complicated ceremonies were common in the Great Lakes region. The Chippewa, Winnebago, and neighboring tribes had a secret society called the Midewiwin

Detail of *Spearing Fish by Torchlight* by Paul Kane, Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Spearfishing was one method of catching fish. Menominee Indians, *above,* used torchlights to lure the fish to the surface. Fish were an important source of food in the Northeast.

Stock Montage

The Iroquois long house was typically made of poles covered with elm bark. Most long houses included separate sections for related families and measured from 50 to 100 feet (15 to 30 meters) in length.

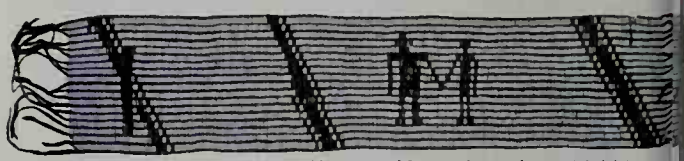
Society. Its members had special songs, rites, and equipment that they used to reach the gods. Some groups, including the Shawnee, Kickapoo, and Potawatomi, made use of *medicine bundles*—bags of such objects as animal skins, pipes, dried herbs, and tobacco. Medicine bundles, sometimes known as *sacred bundles,* were believed to have special powers, and they were opened only during certain ceremonies. Members of the Iroquois False Face Society wore brightly painted wooden masks during their disease-curing rituals.

After European contact. The tribes of the Eastern Woodlands were among the first to meet European explorers and settlers. At first, the two groups had friendly relations. Squanto, a Patuxet, is said to have taught the white settlers how to plant corn and fertilize it with dead fish. Massasoit of the Wampanoag helped the Pilgrims of Plymouth Colony. In 1621, the Indians and Pilgrims joined in a Thanksgiving ceremony to give thanks for a good harvest and peace. But the friendly relations did not last, and warfare soon became common. Most of the early fighting consisted of small battles between settlers and Indians. Smallpox, measles, and other European diseases killed many Indians.

As the settlers moved westward, they took the land for their own. When the Indians objected, fighting broke out. Some of these battles grew into wars. The Northeastern Indians also became involved in the wars between France and Britain for possession of North America. The Indian tribes took sides in these wars and often ended up fighting each other as well as the white settlers. The Huron and many Algonquian groups sided with the French. The tribes of the mighty Iroquois League generally allied themselves with the British and helped Britain gain control of almost all of France's territory in North America.

Algonquian Town of Pomeioc by John White; British Museum, London, Print Room (Michael Holford)

Tall fences called *palisades,* *above,* protected many Northeastern Indian villages from raids by enemies. In many cases, 10 to 30 houses surrounded a central plaza. Most houses were made of poles covered with rush mats, bark, or tree branches.



The Historical Society of Pennsylvania, Philadelphia

A wampum belt given to William Penn by the Delaware marked a treaty between the Indians and the English. Wampum beads were used as money because the Indians valued them.

Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Crafts of the Northeastern and Southeastern Indians included bowls, spoons, and other utensils carved from an abundant supply of wood in those regions. An Iroquois lacrosse stick looked like those of today. The mask, drum and beater, and rattle were used in ceremonies.

The Iroquois League began to split during the Revolutionary War in America (1775-1783). Some members of the league sided with the American colonists, but most supported the British or remained neutral. After the American victory, white settlers poured onto Iroquois lands. Weakened by diseases and conquest, the league fell apart.

Farther west, the Shawnee leader Tecumseh united many of the tribes of the Northeast and Southeast. The Shawnee and some other groups sided with the British during the War of 1812 in an attempt to push the American settlers off their lands. But the Indian resistance ended shortly after Tecumseh was killed in the Battle of the Thames in 1813.

Many tribes from the Eastern Woodlands now live in Oklahoma and various Western states. The U.S. government forced them to move to these areas during the early 1800's. But the Iroquois and some others still live on their original lands. Today, the Iroquois are leaders in the struggle for American Indian rights.

Indians of the Southeast

The Southeast extends from just south of the Ohio River to the Gulf of Mexico and from the Atlantic Coast of southern North Carolina to just west of the Mississippi River. It is a region of mild winters and warm, humid summers. The terrain varies from the mountains of the Appalachians to the sandy coastal plain, with rolling hills and some swamps in-between. Pine forests cover most of the region.

Before European contact. The tribes of the Southeast included the Catawba, Cherokee, Chickasaw, Choctaw, Creek, and Seminole. The Alabama, Coushatta, and a number of other tribes belonged to a federation called the Creek Confederacy. Southeastern Indians spoke many languages, including ones belonging to the Algonquian, Muskogean, and Siouan language families.

Southeastern Indians generally had an abundant supply of food. The adequate rainfall and long growing season enabled them to grow large quantities of corn. A favorite food was *sofkee,* which was made by grinding and then boiling corn. Today, sofkee is known as *grits.* Southeastern Indians also grew beans, squash, pumpkins, and sunflower seeds, and raised turkeys. The women farmed and gathered nuts, berries, and wild plants. Men cleared the land and did most of the hunting and fishing.

People of the Southeast traveled either on foot or in wooden dugout canoes. Dugout canoes were made by burning out the centers of fallen trees with embers and then chopping out the charred wood with stone axes.

Most Southeastern Indian villages had a central plaza with a council house, a public square, and a ceremonial ground. Most houses were made of *wattle and daub*—that is, a wooden frame covered by reed mats with plaster spread over them. Palisades enclosed many villages.

The Indians of the Southeast made deerskin shirts, dresses, leggings, and breechcloths. Women sometimes wore wraparound skirts of woven cloth made of plant fibers. Turkey feathers were sewed onto netting to make robes. The Indians in warmer areas wore little clothing, and many decorated their bodies with tattoos and body painting. Creek and Chickasaw men shaved their heads almost completely, leaving only a small tuft of hair on top. Choctaw men let their hair grow long.

The Southeast area

Major groups:

Ais	Coushatta
Alabama	*Creek
Apalachee	Hitchiti
Atakapa	*Lumbee
*Caddo	*Natchez
Calusa	*Seminole
Catawba	Timucua
*Cherokee	Tunica
*Chickasaw	Yamasee
Chitimacha	Yazoo
*Choctaw	Yuchi

*Has a separate article in *World Book.*

Warfare sometimes broke out among Southeastern Indians. Weapons included bows and arrows and a variety of clubs. Warriors fought for glory and often tattooed their bodies with signs of brave deeds. Elaborate ceremonies accompanied most warfare. Before battle, the warriors gathered in a council house. They painted themselves, performed religious rites, and took special medicines. Sometimes, two tribes would play a stickball game to settle a dispute and thereby avoid a war.

Women had much power and influence among most Southeastern Indians. In most cases, family ties were traced through the mother, and extended families in which all the women were related formed the basic social unit. Cherokee women could attain the position of *war woman* and participate in war councils. A few Cherokee women fought as warriors.

The Southeast had the most complex forms of government north of present-day Mexico. The Natchez, who are now extinct, had a king called the Great Sun. He and his family formed the highest class, the Suns. Below them were two other upper classes, the Nobles and the Honored Men and Women. At the bottom were the commoners. The Natchez built temples and the Great Sun's house on large, flat-topped, earthen mounds.

Many Southeastern tribes had ascending ranks of chiefs. Nearly all chiefs were men. A chief could head a

Creek Indians by George Catlin; The New-York Historical Society

Creek Indians sketched by George Catlin in 1834, *above,* wore clothes made of European cloth. They decorated their garments with a variety of beads, belts, and other ornaments.

Illustration from *The Seminole Indians of Florida* by Clay MacCauley; The Smithsonian Institution, Washington, D.C.

Dwellings called *chickees* were built by the Seminole and were suited to the warm Southeastern weather. These houses had a raised floor and open sides, which allowed air to circulate.

Detail of *A Skin Lodge of an Assiniboin Chief* by Karl Bodmer; The Newberry Library, Chicago, Edward E. Ayer Collection

Tepees were home to the Plains Indians who hunted the huge buffalo herds. An Assiniboine tribe lived in the camp shown above. The woman in the foreground is loading a travois.

village or a whole region of villages or, in the case of a chiefdom, a whole tribe. Typically, some chiefs represented the peace faction. Others represented the war faction. Councils of assistants, advisers, and shamans helped each chief. In most cases, a man inherited his position of chief from his mother's brother, not from his own father.

Religion played an important role in the lives of the Southeastern Indians. The people honored their ancestors and held elaborate funeral ceremonies. Many of the dead were buried with *grave goods*—that is, pottery and other objects—for use in the afterlife. A number of groups worshiped the sun.

The green corn dance was the most important ceremony of the Southeastern Indians. This annual harvest celebration lasted several days and was a time for giving thanks. The dance was thought to maintain harmony and to make things pure again. A new year began when a community fire was lit during the ceremony and a woman from each household took some fire for her hearth.

After European contact. The tribes of the Southeast were among the first Indians to meet European explorers and settlers. Armies, explorers, missionaries, and traders from Europe came through the Southeast looking for gold, slaves, converts to Christianity, fur, and even the Fountain of Youth. As the Europeans took the land for their own, the Indians objected. Warfare between the two groups became common, and many Indians were killed. Many also died from measles, smallpox, and other diseases brought by Europeans.

After the Revolutionary War, the Cherokee and some other Southeastern Indians tried to adopt the ways of white Americans. They began to dress, speak, and act like whites. White people sometimes called the Cherokee, Creek, Choctaw, Chickasaw, and Seminole the Five Civilized Tribes because whites considered their own ways more civilized than Indian customs.

However, white Americans continued to desire Indian lands, and in 1830, Congress passed the Indian Removal Act. This legislation allowed the U.S. government to move Indians living east of the Mississippi River to a territory west of the river. Thousands of Indians died during this forced removal to the West, and the Cherokee came to refer to their westward journey as the Trail of Tears. This term was later applied to the forced removal of other tribes as well. In some cases, a small part of a tribe managed to remain behind in the East. A small group of Cherokee, for example, fled to the mountains of North Carolina. Today, the Indian tribes that remain in the Southeast try to maintain a balance between traditional and modern ways of life.

Indians of the Plains

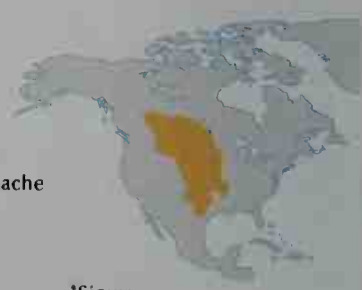
The Plains stretch from just west of the Mississippi River to the Rocky Mountains and from Canada to Mexico. Few Indians lived in this vast grassland region before the arrival of the Europeans. But after the Spaniards brought the horse to the region in the 1600's, a new way of life appeared on the Plains. On horseback, the Indians could follow the great herds of buffalo. After new tribes and white settlers arrived on the Plains, fighting broke out.

Before European contact. Most of the original Plains tribes lived in villages along the rivers and streams where the land was fertile and easily cultivated. Out on the grasslands, the tough sod was hard to farm. The women tended crops of beans, corn, squash, and

The Plains area

Major groups:

*Arapaho
*Arikara
*Assiniboine
*Blackfeet:
Blood
Piegan
Siksika
(North Blackfoot)
*Cheyenne
*Comanche
*Crow
*Gros Ventre
Hidatsa
*Iowa
*Kansa
*Kiowa
Kiowa-Apache
*Mandan
Missouri
*Omaha
*Osage
Oto
*Pawnee
Ponca
Quapaw
*Sioux:
Santee
Teton
Yankton
Tonkawa
Wichita



*Has a separate article in *World Book*

tobacco while the men hunted deer, elk, and sometimes buffalo. During the summer, the Indians left their villages to hunt the vast buffalo herds on the Plains. The huge beasts were difficult to hunt on foot, and so the men tried to stampede herds of them off cliffs or into areas where they could be killed more easily. In the fall, the Indians returned to the villages and harvested their crops. They pulled the slain buffalo home on travois, which were made by fastening a platform to two poles. Sometimes the Indians used dogs to pull the travois.

The early Plains Indians wore deerskin breechcloths, leggings, and simple shirts. They used buffalo hides for winter robes and moccasin soles. While in their villages, the tribes lived in earth lodges, frames of logs covered with brush and dirt. Out on the Plains, they lived in tepees made of animal skins.

After European contact. The coming of the horse and gun greatly changed life on the Plains. With the horse, Indians could leave their villages and follow the buffalo herds—which they could not do on foot. Buffalo meat became their main food. The flesh could be roasted over a fire, dried in the sun to make *jerky,* or pounded with berries and suet to make pemmican. The Indians used buffalo skins to make clothing, bedding, and tepees. They made the bones and horns into tools and utensils and used dry buffalo manure for fuel. The tribes held many ceremonies aimed at assuring a large enough supply of buffalo.

The tribes on the eastern Plains, sometimes called the Prairies, continued to farm part of the year and to live in earth lodges. But on the western Plains, often referred to as the True Plains, daily life became centered on the vast buffalo herds. The buffalo hunters stayed on the move continually. As a result, large tepees, which could be moved from camp to camp, replaced earth lodges as the principal dwellings on the True Plains. The Indians used horses to haul their possessions on large travois. A good buffalo hunter might have two or more wives to prepare all the buffalo hides he brought home.

Nearby tribes, and those forced westward by the advancing white people, quickly adopted the Plains way of life. These late arrivals on the Plains included the Arapaho, Blackfeet, Cheyenne, Comanche, and Sioux.

With many new tribes on the Plains, communication required some kind of common, easily understood language. This need led to the development of the Indian sign language.

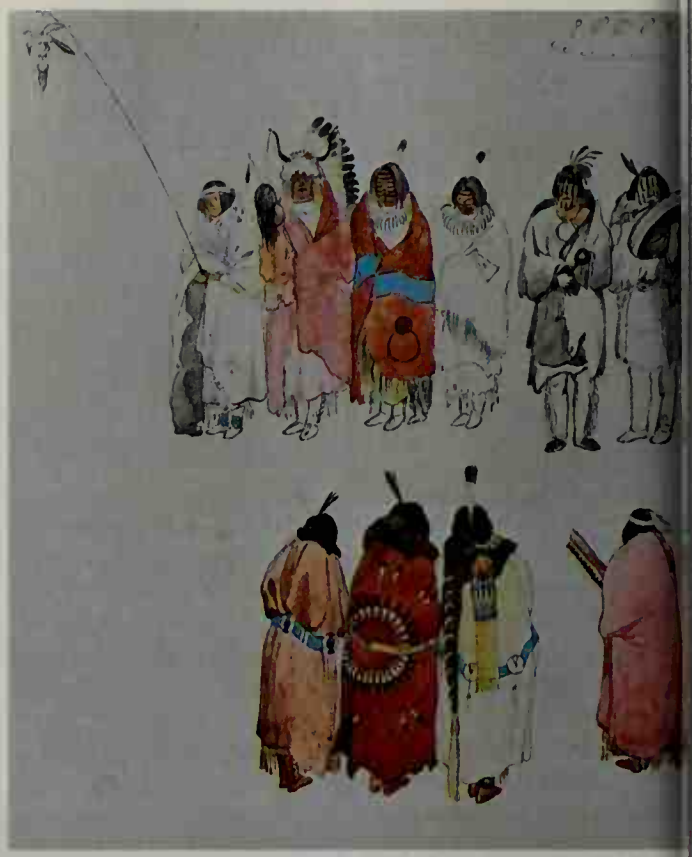
The increasing number of tribes on the Plains fought with one another and with the whites. Success in warfare earned fame for a warrior. Counting coup—that is,

The Interior of the Hut of a Mandan Chief by Karl Bodmer; Rare Book Division, New York Public Library, Astor, Lenox, and Tilden Foundations

A Mandan chief smokes his pipe in his lodge. Favorite horses and dogs were kept inside the lodge, and utensils and weapons were hung on beams and posts that supported the domed roof.

Mah-to-toh-pa (The Four Bears) by George Catlin, The Smithsonian Institution, Washington, D.C.

The ceremonial dress of a Mandan chief included a long headdress of eagle feathers topped by buffalo horns. Hair from enemy scalps hangs from his clothing.



Sketches by Karl Bodmer; Joslyn Art Museum, Omaha, Nebr., Northern Natural Gas Company Collection

Victory dances celebrated success in battle. Men and women of the Hidatsa tribe, *above,* tied the scalps of slain enemies on a pole and danced to the rhythm of rapid drumbeats.

the act of touching a live enemy and getting away from him—won the highest honor. After battle, the warriors told of their heroic deeds and celebrated their victory. Eagle feathers were awarded for bravery.

The religion of the Plains Indians centered on spiritual power. Almost every Indian man and some women had a personal guardian spirit that they had seen during a vision quest. Tribes also had medicine bundles containing plants, stones, and other objects with supposed supernatural powers. The most important ceremony was the sun dance.

Colored engraving (1853) by an unknown artist based on a work by Seth Eastman, Granger Collection

Indian farmers on the Plains grew corn and other crops. The women generally tended the crops, and the men hunted. Work in the cornfields included scaring away harmful crows, *above.*

The widespread killing of buffalo, particularly by white hunters, threatened to wipe out the great beasts. By 1890, the buffalo herds had almost disappeared—and with them, the Plains way of life. In their place came increasing numbers of ranchers and settlers who turned the Plains into cattle ranches and homesteads. The federal government moved many tribes onto reservations and hoped they would take up farming. But the Plains Indians considered farming to be the work of women or white people. They turned instead to warfare and, later, to religious movements. One such movement was the Ghost Dance religion, which some Indians believed would bring back the buffalo and remove the settlers from Indian land.

The last major conflict between the Plains Indians and the U.S. Army took place in 1890. Federal troops trapped and massacred as many as 300 Sioux men, women, and children at Wounded Knee in South Dakota.

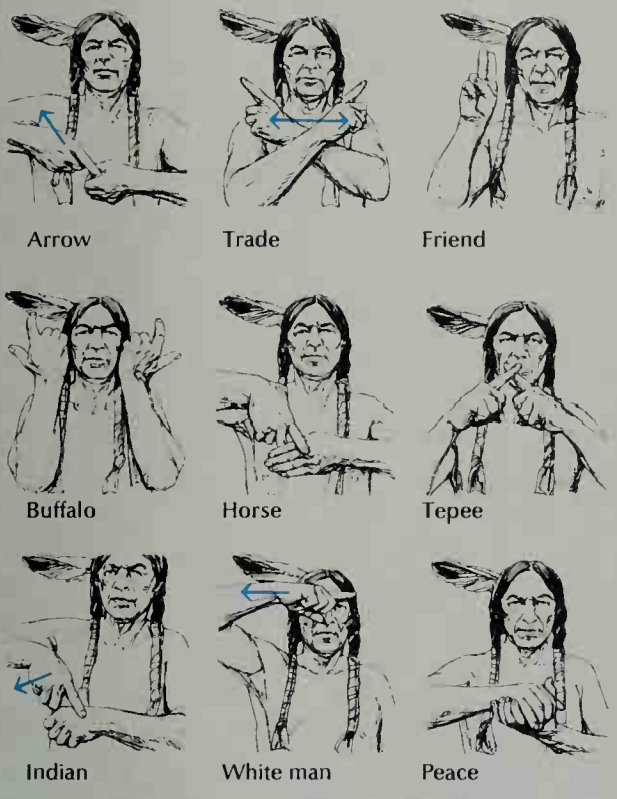
Today, many Plains Indians still perform the sun dance and other traditional ceremonies. In addition, the Cheyenne and Comanche in particular have become leaders in the Native American Church. Some Sioux are well known for their activities in the American Indian Movement (AIM), a civil and treaty rights organization.

Indians of the Northwest Coast

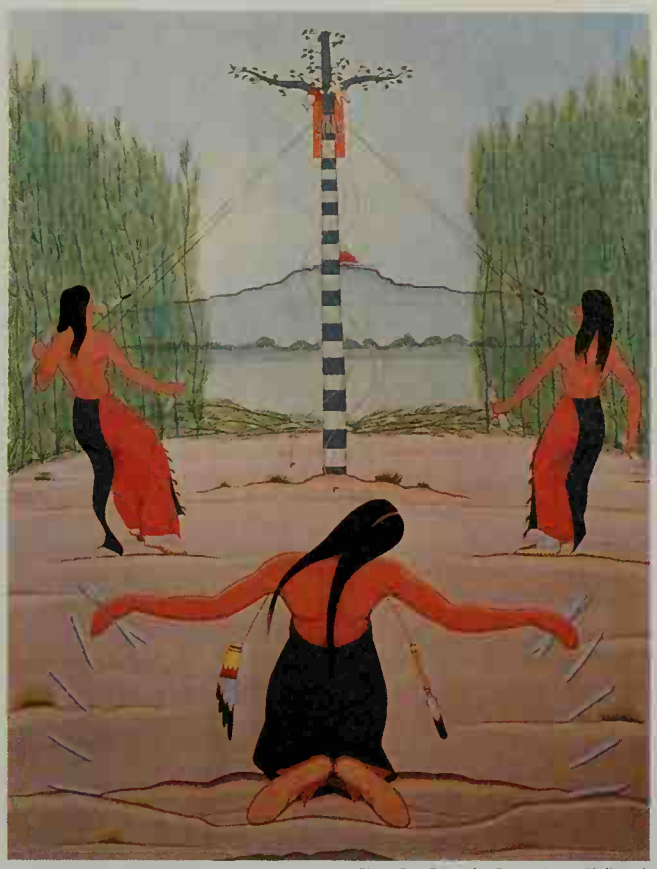
The Northwest Coast stretches along the Pacific Ocean from southern Alaska to northern California. Fish

Indian sign language

Many languages were spoken on the Plains. As a result, Plains Indians often communicated by sign language. The arrows indicate the direction of hand movements.

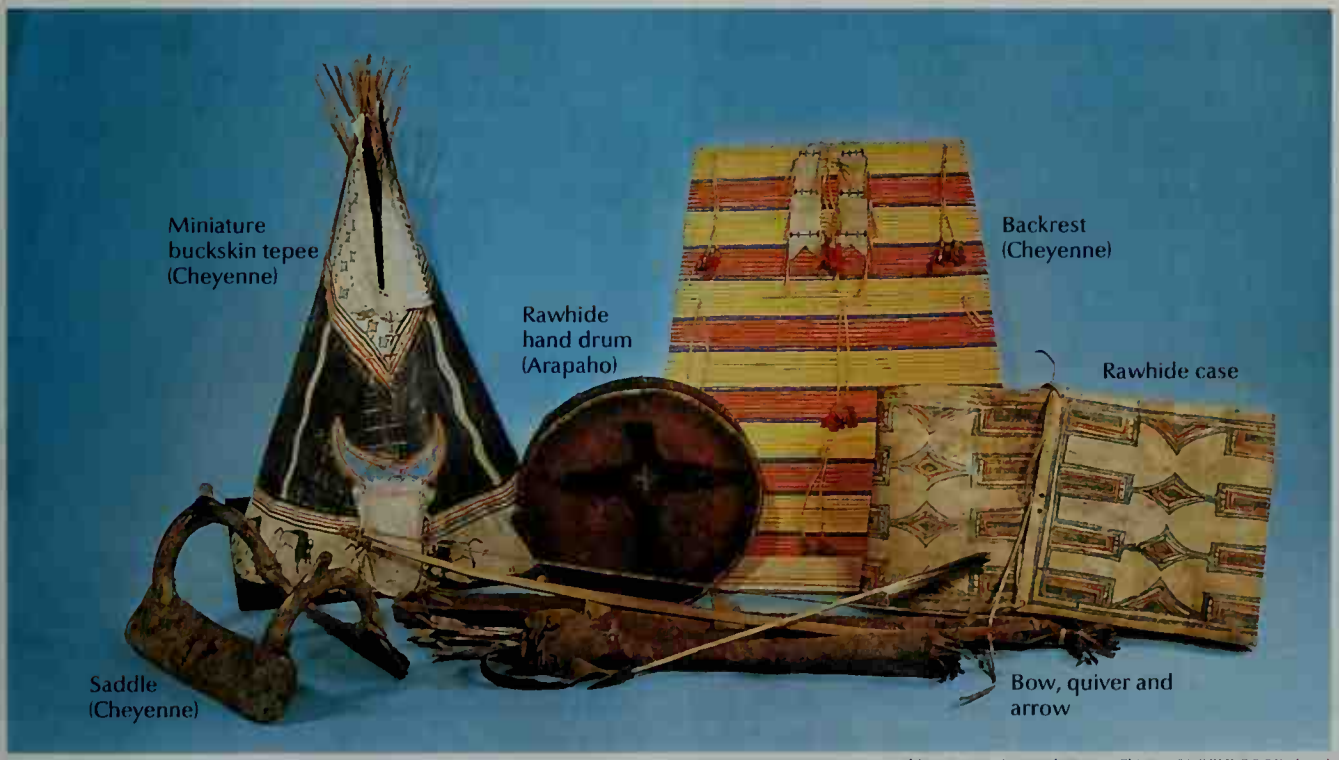


WORLD BOOK illustrations by Anthony Saris



Sioux Sun Dance by Oscar Howe; Philbrook Art Center, Tulsa, Okla., Gift of Clark Field

Sun dance ceremonies often lasted several days. Young men of the Sioux tribe, *above,* demonstrated their courage by attaching strings to their chests and tugging until they tore free.



Field Museum of Natural History, Chicago (WORLD BOOK photo)

Crafts of the Plains Indians included personal belongings decorated with painted designs. A rawhide case, known as a *parfleche,* carried food. The backrest was made of willow sticks.

The Northwest Coast area

Major groups:

Bella Bella	Eyak
*Bella Coola	*Haida
*Chinook	*Kwakiutl
†Coast Salish	*Nootka
Chehallis	Quileute
Nisqually	†Tillamook
Puyallup	*Tlingit
Quinault	*Tsimshian

*Has a separate article in *World Book*.
†See Salish.

and seafood are plentiful in the ocean and the rivers of the region. Thick forests rise sharply from the beaches and include giant redwoods, Douglas-fir, and pine trees. The region has a mild, humid climate.

Before European contact. Among tribes of the Northwest Coast, a few families had great influence in each village because of their ancestry and wealth. Indians in the north traced family ties through the mother; those in the south, through the father. Tribes measured wealth in terms of such possessions as canoes and blankets. Other valuable property included slaves—captured members of enemy groups or their descendants. But sheets of copper, hammered into shield shapes, had the greatest value of all. These sheets are sometimes called *coppers*.

Men—and some women—of wealth and social position proved their right to high rank at a feast called a *potlatch*. During a potlatch, which lasted several days, a host fed the guests and gave away many valuable items. The gifts gained respect for the host and the host's clan and indicated the social rank of the individuals who received the gifts. Some potlatches were held to mark births, marriages, and deaths. During *rival potlatches*, hosts destroyed a valuable copper shield to challenge

Babbine Chief by Paul Kane; Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Wide-brimmed hats protected the Northwest Coast Indians from frequent rain. A chief's hat, *above*, was woven from finely twisted spruce roots and decorated with painted designs.

Detail from *Clallum Women Weaving a Blanket* by Paul Kane; Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Blankets and robes helped keep Northwest Coast Indians warm in chilly weather. Inside a Coast Salish house, *above*, one woman weaves a blanket while another spins wool into yarn.

Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Crafts of the Northwest Coast Indians included valuable copper shields, which were given away at feasts called *potlatches*. Masks were part of many religious ceremonies.

Detail of a painting of a Northwest Coast village by T. Mower Martin; Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

A Northwest Coast Indian village was typically built near a lake, a stream, or the sea. These waters had a plentiful supply of fish. Game was abundant in the region's thick forests, which were also a source of wood for building plank houses and sturdy canoes.

their rivals to outdo them at another potlatch.

Food from the sea included not only salmon and a variety of fish, but also seals, sea otters, sea lions, whales, and other animals. Plentiful land animals included bear, caribou, deer, elk, and moose.

The Northwest Coast tribes made elaborate boxes, masks, grave markers, and utensils from wood. They built houses with large posts and beams, covered with planked sides and gabled roofs. Several families lived in one of these large structures.

Great seagoing canoes—some more than 60 feet (18 meters) long—were burned and cut from the trunks of huge cedar and redwood trees. The canoes could hold as many as 60 people. The Indians carved or painted designs on many of these vessels.

The Northwest Coast people believed in a large number of gods. During the winter, secret societies dramatized various myths. These performances were mainly religious ceremonies. But elaborate costumes, masks, and settings—plus singing and dancing—made them highly entertaining as well.

After European contact. The Indians of the Northwest Coast came into contact with Europeans later than did the tribes of most other regions. But by 1800, fur trading flourished among the coastal tribes. The iron tools brought by the white traders aided the skilled Indian carvers. Large totem poles, carved from tree trunks, became more common. The totem poles, which stood in front of homes and in other public places, showed the social rank and ancestry of a family or of an individual.

The coming of white people began the end of the Indian way of life almost everywhere in the Americas. But the Northwest Coast Indians adapted to the new ways better than most tribes did. In time, some Indians bought motorboats and started to sell their fish catches to commercial packers. Others took jobs in canneries or began to raise potatoes. However, the potlatch and other important ceremonies are still carried out today.

Indians of California

The California culture area includes much of California. The area extends from the southern edges of Oregon in the north to Baja, in Mexico, in the south. It stretches from the Sierra Nevada in the east to the Pacific Ocean in the west. The landscape of the region varies from the northern redwood forests to the southern deserts. The climate is generally mild.

Before European contact. More languages were spoken in California than in any other culture area of North America. The Indians of the region spoke languages belonging mainly to the Aztec-Tanoan, Hokan, Macro-Algonquian, Penutian, and Na-Dene language groups.

Tribes in the California area consisted of one or a few

The California area

Major groups:

Achumawi	*Miwok
Atsugewi	Monache
Cahuilla	*Pomo
*Chumash	Shasta
Costanoan	Tipai
Hupa	Wappo
Ipai	*Wintun
Karok	Yana
Luiseño	*Yokuts
*Maidu	*Yurok

*Has a separate article in *World Book*.

Dance of the NW Indians at the Mission of San Jose de California, believed to be by Charles H. Stephens, The Newberry Library, Chicago, Edward E. Ayer Collection

California Indians painted their bodies for ceremonial dances. The Indians of this warm area had little clothing. The men wore a breechcloth, and the women wore simple aprons or skirts.

villages of extended families. Many of these tribes were led by chiefs, most of whom were men. Chiefs organized ceremonies and gave advice about hunting, gathering, and fishing.

Acorns were the most important food. Women gathered acorns, washed them, and pounded them into flour. The women then cooked the flour to make acorn mush or bread. Women also gathered pine nuts, mesquite beans, grass seeds, cactus fruits, and berries. They collected clams and other shellfish along the seacoast. The men hunted such game animals as bighorn sheep, deer, elk, and pronghorns. Some coastal groups hunted seals and other sea mammals. Salmon was the main fish caught.

Housing varied greatly. Houses in the north were made of wooden planks. Farther south, some Indians built cone-shaped dwellings that consisted of rush mats, brush, or slabs of bark on frames of poles. Others lived in *pit houses.* These shelters were dug several feet into the ground and had roofs and sides made of mud and other materials.

California Indians wore little clothing. Men typically wore animal-skin breechcloths, and women donned animal-skin aprons or skirts. In cold weather, men and women wore robes made of rabbit skins or feathers to keep themselves warm. California Indians often painted their bodies for ceremonies.

California Indians believed that people differed from one another because they had different amounts of spirit power. Many tribes held *world renewal ceremonies* to prevent the spirit power in the universe from disappearing. These ceremonies were also designed to ensure an adequate supply of food. Some groups of California Indians feared ghosts.

The Pomo were famous for their basket making. Pomo women crafted watertight baskets that they decorated with beads, feathers, and shells.

After European contact. During the 1500's, Spanish explorers became the first Europeans to have contact with the California Indians. After Spanish missionaries established missions in the area during the 1700's, they encouraged and sometimes forced the Indians to live at these settlements and learn farming and cattle herding. The Indians who converted to Christianity and settled on missions became known as *Mission Indians.*

The population of the California Indians dropped greatly after contact with Europeans. New diseases brought by the Spaniards and later settlers took many Indian lives. After gold was discovered in California in the 1800's, more Indians were killed by the gold miners who came to the region to seek their fortune. Today, the surviving tribes of California Indians struggle to maintain their traditions.

Indians of the Great Basin

The Great Basin includes Nevada and Utah and parts of Oregon, Idaho, Montana, Wyoming, Colorado, New Mexico, Arizona, and California. Much of the area is desert, with scattered grasses and sagebrush. Pine forests rise in the mountains and along streams and lakes. Summers are hot. In the northern part of the Great Basin and in the mountains, winters can be cold.

Before European contact. The tribes of the Great Basin consisted of many small bands, some no larger than extended families. Family ties were traced through both parents. Each band had a home territory near a lake or a stream that provided a reliable supply of water and fish.

Pine nuts were the most important single source of food for Great Basin Indians. Other wild plants used for food included acorns, beans, a type of lily called camas, mesquite, ricegrass, wheatgrass, and wolfberries. A few groups grew corn, beans, and squash. Great Basin Indians fished in the area's lakes and streams, where they

The Great Basin area

Major groups:

*Bannock	*Ute
Gosiute	*Washoe
Kawaiisu	
*Paiute	
*Shoshone	

*Has a separate article in *World Book*.

Detail of *Shoshone Indian Preparing His Meal* (1860), an oil painting on canvas by Alfred Jacob Miller; Walters Art Gallery

A Shoshone Indian prepares a meal, *above*. Great Basin Indians ate mainly pine nuts and other wild plants, but they also dined on fish and the meat of pronghorn, rabbit, and other game. After the introduction of the horse, some Great Basin Indians became buffalo hunters.

caught mainly salmon, trout, and whitefish. They also hunted such game as pronghorns and rabbits.

Men in the south typically wore animal-skin breechcloths, and those in the north wore moccasins, leggings, and fringed shirts. Women in the south generally wore animal-skin skirts, and those in the north wore dresses, knee-length leggings, and moccasins. In the winter, rabbit-skin robes provided warmth for men and women in both the north and the south.

Shelters varied with the season. In warmer weather, Great Basin Indians built brush windbreaks. In the winter, they constructed a conical shelter of pine poles covered with such materials as sod, bark, grass, and animal skins.

Great Basin Indians believed the world around them was inhabited by spirits. Shamans were thought to have the ability to heal people and improve hunting. Guardian spirits were important. Initiation ceremonies for girls reaching adulthood were common. Great Basin Indians also frequently held *round dances*. In these dances, dancers linked arms and circled a central pole or tree. Round dances were held to ask for rain, to make the plants grow, to ensure a good hunt, and for many other reasons.

After European contact. The way of life changed dramatically for many Great Basin Indians following the introduction of the horse by the Spaniards. By the 1700's, the Bannock, Shoshone, and Ute in particular had become buffalo hunters like the Plains Indians.

Further changes occurred among the Great Basin Indians after gold, silver, and other minerals were discovered in the area. Miners and other settlers poured into the region, and the Indians were pushed from their homes. The settlers' cattle and sheep ate many of the wild plants that the Indians depended on for food. In some areas, sections of the pine forests, which provided the Indians with pine nuts, were cut down for lumber.

Today, many Great Basin Indians live as ranchers and farmers. Some tribes earn money by leasing mining sites on their land.

Indians of the Plateau

The Plateau covers most of the southern half of British Columbia east of the coastal mountains. It also includes parts of Washington, Oregon, Idaho, and Montana, as well as a small section of northern California. Forests and grasslands cover most of the north. The south is semidesert.

Before European contact. The tribes living in the Plateau consisted of bands of extended families. Each band lived in its own territory but was related through marriage to other bands in the tribe. During the summer, bands traveled their territory in search of food. In the winter, they lived in villages. Each village had one or more respected leaders, most of whom were men. These leaders gave advice and helped settle disputes.

The main foods eaten by Plateau Indians were wild bulbs and roots, including camas and bitterroot; such berries as blackberries and huckleberries; and salmon and other fish. Women gathered the berries and dug the roots and bulbs. Men did the fishing. They also hunted rabbits and other game.

Plateau Indian men often wore robes, and women wore dresses. These garments were typically made of

Indian Camp Colville (about 1855), an oil painting on canvas by Paul Kane; Royal Ontario Museum, Toronto

A Nez Perce camp featured temporary shelters that were easy to build and take apart, *left*. During the summer, bands of Plateau Indians traveled their territory in search of food. After these Indians acquired horses, buffalo herds became a major source of food, particularly for the Nez Perce.

The Plateau area

Major groups:

Cayuse	Nicola
Coeur d'Alene	Okanagan
†Flathead (Salish)	Palouse
Kalispel	Sanpoil
*Klamath	Shuswap
*Kutenai	Spokane
Lillooet	Thompson
*Modoc	Umatilla
*Nez Perce	Walla Walla
	Wanapam
	Yakima

*Has a separate article in *World Book*.
†See Salish.

the skins of deer or mountain sheep or goats, but they could also be made of woven bark fibers. The clothing of some groups included buckskin leggings, moccasins, shirts, and dresses. Nez Perce and many other Plateau Indian women became famous for the basket hats that they wove out of dried leaves.

In the winter, most Plateau Indians lived in warm pit houses. These shelters were typically built by digging a large, round hole in the ground and placing posts in a circle to form the walls. The cone-shaped roof was covered with dirt. People often entered the dwelling through the smoke hole in the roof. In the summer, Plateau Indians lived in temporary brush or mat-covered shelters that were easy to build and take apart.

Plateau Indians believed shamans could heal people and had some control over the spirit world. Both boys and girls went on vision quests to seek out guardian spirits. During round dances, the dancers sometimes went into trances and had visions.

After European contact. During the 1700's, some Plateau Indians acquired horses, which the Spaniards had introduced to the New World. The Nez Perce in particular then began to hunt buffalo as the Plains Indians did.

The first white people to have direct contact with the Plateau tribes were the American explorers Meriwether Lewis and William Clark. They traveled to the region during their famous expedition of the early 1800's along with Sacagawea, a Shoshone woman who served as interpreter. The Plateau Indians had generally friendly relations with the fur traders who soon followed. In the mid-1800's, however, settlers and miners began to take Indian lands. They also brought many deadly diseases, including smallpox and scarlet fever, to the area. The Indians struggled to keep their lands, and two of the most famous Indian wars of the 1800's were fought by the Plateau Indians. They were the Modoc War (1872-1873) and the Nez Perce War (1877). Today, many Plateau Indians live on reserves in Canada and reservations in the United States.

Indians of the Southwest

The Southwest, a huge, dry region, includes Arizona, New Mexico, southern Utah, southern Colorado, and northern Mexico. In the northern area of the Southwest, wind and water have formed steep-walled canyons, sandy areas, buttes, mesas, and other landforms. In the south, the mountains give way to flat, desert country. The Rio Grande and the Colorado, Gila, and Salt rivers cut through the Southwest region.

Before European contact. The early Indians of the Southwest included several tribes. The Anasazi built cliff houses in the northern area. The Hohokam dug long irrigation canals in central Arizona. The Mogollon hunted and farmed along the rivers of eastern Arizona and western New Mexico. The Pueblo tribes, most of whom were descended from the early Anasazi Indians, had one of the most highly developed civilizations in North

America. Most Pueblo lived in villages and farmed along rivers that provided water for irrigation. Their name—*Pueblo*—comes from the Spanish word for *village*.

The Pima, Quechan, and Tohono O'odham (also known as Papago) also farmed, though hunting and gathering provided much of their food. They lived in villages but moved from place to place with the changing seasons. The Navajo and Apache were other hunting and gathering tribes that traveled about in small bands in search of food. These groups came to the Southwest much later than the Pueblo. They often raided the Pueblo people.

The Pueblo depended on corn, beans, and squash for most of their food. They also raised turkeys. Water was important to them because enough rain meant the difference between plenty of food and starvation. Throughout the year, the Pueblo held religious festivals and ceremonies that were aimed at bringing rain and making their crops grow.

The Pueblo were excellent craftworkers. The women made handsome pottery and decorated it with painted designs. They spun yarn from cotton that they grew and wove it into cloth. The men wore cotton breechcloths and cotton kilts. Women wrapped cotton cloth around their bodies and fastened it under the left arm and over the right shoulder. Around their legs they wore buckskin wrappings that reached to the top of their moccasins. After the Spaniards introduced sheep to the Southwest, the Pueblo began to weave woolen cloth for clothing.

The Pueblo built large, many-storied homes of adobe and rocks. These dwellings housed many families—and some held an entire village. The people usually entered by ladders through the roof. The ladders could be removed in case of enemy attack. They provided protection from the frequent raids by the Apache and Navajo.

The Southwest area

Major groups:

*Apache
Chiricahua
Cibecue
Jicarilla
Lipan
Mescalero
San Carlos
Tonto
White Mountain
Coahuiltecan
Cocopa
Havasupai
Jumano
Karankawa
Maricopa
Mayo
*Mohave
*Navajo
Tohono O'odham
*Pima
*Pueblo:
*Hopi
Keresan
North Tiwa
South Tiwa
Tano
Tewa
Towa
*Zuni
*Quechan
Seri
Tarahumara
Tehueco
Tepecano
Tepehuan
Walapai
*Yaqui
Yavapai

*Has a separate article in World Book.

Royal Ontario Museum, Toronto (special photo for WORLD BOOK)

Crafts of the Southwestern Indians included excellent pottery. A plain pot was used for cooking. The deer was a favorite figure on bowls made by the Zuni. A red line usually ran from the deer's mouth to its heart. The throwing stick was used much as a boomerang to hunt small game.

Pansy Stockton Collection (Laura Gilpin)

Kachina dolls were given to boys and girls. By playing with these dolls, the children learned to identify the real kachinas.

Navajo Weavers by Harrison Begay; Philbrook Art Center, Tulsa, Okla.

The craft of weaving was taught to the Navajo by the Pueblo Indians, probably during the 1700's. Through the years, the Navajo have become famous for their woolen blankets and rugs.

Sometimes the Pueblo built their dwellings into the sides of steep cliffs, which provided additional protection against attack.

The Pueblo usually fought only when attacked. If a Pueblo killed someone—even in warfare—that individual had to go through a long period of self-purification before returning to live in the village.

The Apache and Navajo, on the other hand, were fierce fighters. These two groups raided the Pueblo in search of food and goods. The Navajo and Apache both learned some farming from the Pueblo, but they depended chiefly on hunting and gathering for their food. They hunted game, including deer, pronghorns, and rabbits, and gathered cactus fruit, roots, piñon nuts, and other plant food.

The Navajo and Apache wore skin garments, though the Navajo later adopted loom weaving and Pueblo dress. A Navajo family lived in a mud-covered log hogan. The Apache did not have permanent houses. Some of these Indians lived in brush shelters, and others lived in tepees.

After European contact. Francisco de Coronado, a Spanish explorer, was one of the first Europeans to meet the Southwest Indians. He met the Rio Grande Pueblo in 1540 while searching for the Seven Cities of Cibola, legendary places reported to be rich in gold. Soon afterward, the Spaniards established Roman Catholic missions among the Pueblo. The Spaniards attempted to teach the Indians Christianity and forbade them to perform rainmaking ceremonies. However, the Indians continued to practice their old religion, and the Spaniards punished them. Many Pueblo people were killed.

The Pueblo, directed by Popé and several other Indian leaders, revolted in 1680. The Spaniards again conquered them by 1700. This time, many Pueblo fled to live with the Navajo and other Southwest Indians.

The Navajo learned new ways—both Pueblo and European—from the Pueblo. These included fruit growing, sheep raising, and cloth weaving. The Navajo also adopted Pueblo religious practices, such as chanting, masked dancing, and sand painting. Sand painting, sometimes called *dry painting,* became an important part of Navajo curing ceremonies. In sand painting, grains of sand, ground-up minerals, and seeds of various colors are arranged into designs.

Today, the Navajo are one of the largest Indian groups in the United States. They number about 200,000, many of whom live on a reservation that lies chiefly in Arizona but also covers part of New Mexico and Utah. The Navajo have become noted for weaving blankets and rugs and making silver jewelry. Some raise sheep and cattle, but the land is dry and overgrazed. The Apache became famous for their bravery and fierce fighting. Most of the remaining Apache also live on reservations. The Pueblo never completely gave up their religious practices, even under Spanish rule. They—and

Detail of *Hopi Ceremonial Dance* by Fred Kabotie; Philbrook Art Center, Tulsa, Okla.

Kachina dancers performed at Pueblo ceremonies to ensure good crops. The masked men chanted and danced to the rhythm of their rattles. The striped dancers are clowns. The Kachina dancers visited children to learn if they had been good. If not, the dancers might punish them.

most Southwestern Indians—have been successful through the years in preserving their traditions.

Indians of Middle America

The Middle American Indians lived in what are now Mexico, Guatemala, and Honduras. Part of this region lies in the tropics, but the altitude in the mountainous areas and on the plateaus of Mexico makes the weather comfortable the year around.

Before European contact. The Indians of Middle America were the first farmers of the New World. Agriculture probably began by about 7000 B.C. By 2000 B.C., permanent villages began to appear as the people cultivated corn, beans, squash, and other crops. With farming, the land could support a large population, and some of the people were freed from the continual search for food. More time could be dedicated to arts and crafts, trade, government, and religion. Great cities grew, and the Maya and the Aztec civilizations became two of the most highly developed in the Americas.

One of the first major centers of Middle American civilization was that of the Olmec Indians on the southern Gulf Coast in what are now the Mexican states of Veracruz and Tabasco. Between 1200 B.C. and 400 B.C., these Indians developed both a counting system and a calendar. Ruins of an Olmec ceremonial center have been discovered at La Venta in Tabasco. The site featured an enormous pyramid and was surrounded by platforms and mounds. Four huge heads carved from basalt—the largest about 8 feet (2.4 meters) tall and weighing about 15 short tons (14 metric tons)—have been found at La Venta. Scientists believe the heads represent rain spirits. Fine pieces of pottery and jade carving have also been found on this site.

Between about A.D. 100 and 700, Teotihuacán became the largest Indian city of the ancient Americas. With a population of nearly 250,000, it rivaled in size many European and Asian cities of the time. The city's cultural and economic influence spread through most of Mexico and into Guatemala. Teotihuacán's vast ruins of pyramids, palaces, and apartment complexes can still be seen just north of present-day Mexico City.

Other great Indian civilizations peaked in Middle America between about A.D. 250 and 900. The Maya built large cities that had tens of thousands of inhabitants. The Maya also studied the stars from observatories and invented a system of writing. Another advanced civilization was developed by the Zapotec Indians. They had

The Middle American area

Major groups:
*Aztec
*Maya
*Mixtec
*Olmec
Otomí
*Tarascan
*Toltec
Totonac
*Zapotec
Zoque

*Has a separate article in *World Book*.

their capital city at Monte Albán, in what is now the southern Mexican state of Oaxaca.

The cities of Middle American Indians included ceremonial structures, such as pyramids, temples, terraces, and courts. The Middle American Indians worshiped rain gods, a sun god, and a corn god. They decorated their temples with stone carvings. A ball court formed part of most cities. Most of the Middle American Indians played a game in which they tried to bounce a ball through a hoop.

Farmers in Middle America used raised fields and terraced hillsides to make the most of their fertile land. Middle American Indians built houses of poles and covered them with roofs made of leaves and grass. Some houses had roofs made of mud.

Both men and women wore a coatlike top garment. The men wore a breechcloth under it, and the women wore a wraparound skirt. The poorer Indians wore cloth made of the fibers of maguey plants, but the others dressed in cotton cloth. Priests and some other leaders often wore feathered headpieces and elaborate jewelry.

Warfare became widespread in Maya areas of Middle America during the 700's as competition for resources increased. During the 900's, the Toltec Indians established an empire in central Mexico and may have conquered part of the Maya empire in the Yucatán Peninsula. The Aztec controlled the Valley of Mexico and the surrounding area from the 1400's until the Spaniards conquered them in 1521.

A king, chosen from a noble family, ruled the Aztec. He was aided by a council of high-ranking individuals, some of whom were priests. The Aztec waged war for political and economic reasons and also to take captives. They often sacrificed prisoners to the gods.

Peabody Museum of Archeology and Ethnology, Harvard University, Cambridge, Mass.

The Maya built a remarkable civilization in Middle America. Scenes of a waterside village, *above,* were copied from the walls of the Temple of Warriors at Chichén Itzá. The Maya erected large cities inhabited primarily by the nobility and the priestly classes. Most people lived in small villages.

Tenochtitlan (pronounced *tay nohch TEE tlahn*), the Aztec capital, stood on an island in Lake Texcoco, the site of present-day Mexico City. When Hernando Cortés and his Spanish troops arrived in Tenochtitlan in 1519, the city had a population of about 200,000 to 300,000. The people grew much of their food on artificial islands called *chinampas* that they made by scooping up mud from the lake bottom. For an old map of Tenochtitlan, see **Mexico** (picture: The Aztec capital).

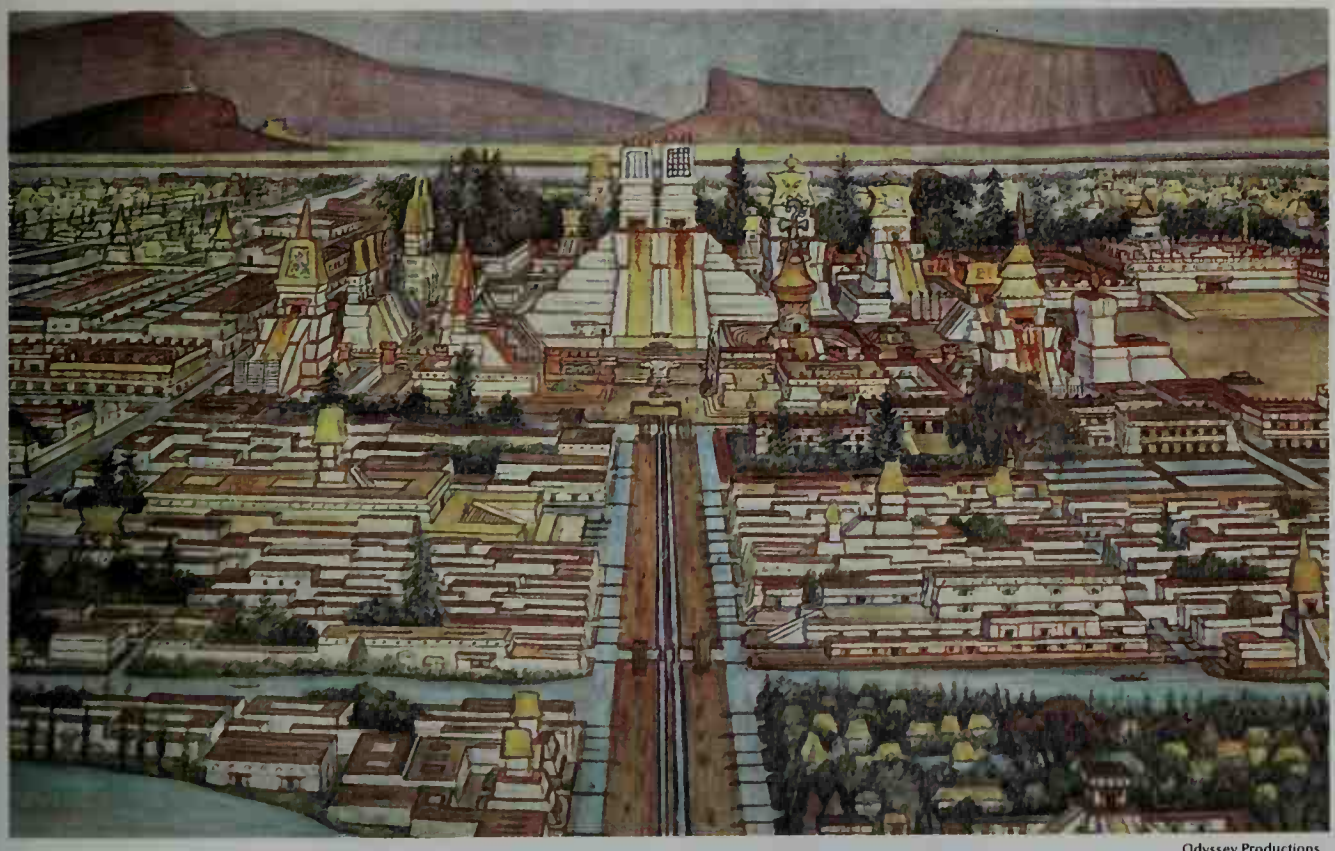
After European contact. Montezuma II ruled the Aztec when Cortés landed in Middle America. The Spaniards conquered large armies of coastal Indians, who had never seen cannons or horses. As Cortés moved inland, he enlarged his army with members of neighboring tribes who hated the Aztec. The Aztec had seized food and goods from these tribes and had sacrificed captives to the gods.

Montezuma did not oppose the advancing Spaniards. Some scholars think he feared Cortés might be the god Quetzalcóatl or his representative. Cortés entered Tenochtitlan and made Montezuma a hostage. The Spaniards treated the Aztec people badly, and the Indians revolted in 1520. They drove the Spaniards from the city. But the Spaniards reentered Tenochtitlan in 1521 and quickly destroyed it. Thousands of Aztec were killed.

Diseases brought by the Spaniards killed many Indians of Middle America, and the conquerors enslaved many others. Missionaries tried to convert the Indians to Roman Catholicism. Many Indians adopted the new reli-

The Carnegie Institution of Washington, D.C. (WORLD BOOK photo by Robert Crandall)

A Maya chief pricks his tongue to add his blood to a sacrifice being made to the gods. The Maya worshiped many gods. The scene above is copied from a mural in Bonampak, Mexico.



Odyssey Productions

The Aztec capital of Tenochtitlan had about 200,000 to 300,0000 people when the Spaniards arrived. A large ceremonial center stood in the center of the city. Temples to two favorite Aztec gods rose atop the great pyramid, *center*. The Aztec empire fell quickly to the Spaniards in 1521.

American Museum of Natural History, New York City
(WORLD BOOK photo by Lee Boltin)

The arts of Middle America are world famous. This Maya pottery and Mixtec folding book show the fine painting of the region. The book's 52 pages trace the Mixtec history from mythical beginnings to about A.D. 1350. Many Middle American tribes used conch shells as musical instruments.

gion, but they combined it with a number of their old beliefs. In rural areas, Indian life changed little. Agriculture remained the main activity.

Today, Middle America has the largest Indian population in the Americas. The Indians range from political leaders in the Mexican and Guatemalan governments to people in isolated tribes. Some Indians of the Maya area still speak a Maya language, but they no longer read the ancient writing.

Indians of the Caribbean

The Caribbean Indians lived throughout the southern half of Central America, the northern parts of what are now Colombia and Venezuela, and on the islands of the Caribbean Sea. Although this region lies in the tropics, sea breezes or high altitudes make the climate pleasant throughout the year.

Before European contact. Important Caribbean tribes included the Arawak of the islands and coastal areas, the Lenca and Cuna in Central America, and the Chibcha in Colombia. Most Caribbean Indians lived in thatched houses that stood around the center of the community. In the center were the chief's or king's dwelling and the temples. A palisade surrounded many towns. The chief was the leader of the town, but sometimes brave warriors were chosen to lead the tribe in war.

Warfare played an important part in Caribbean life. Success in battle led to higher rank for men, and the chief and other leaders had special privileges. The chief, for example, was expected to have several wives, and other members of the tribe cultivated his land. Warfare also enabled tribes to take captives and make them slaves.

Agriculture provided most of the food, but much came from the sea and rivers. Both men and women helped raise avocados, beans, cassava, corn, peanuts, peppers, pineapples, and sweet potatoes. Most of the tribes of the Caribbean area brewed a type of beer from corn.

Most of the people wore clothes of cotton cloth, which they wove on looms. The Arawak made their

The Caribbean area

Major groups:

*Arawak
*Carib
*Chibcha
Choco
Ciboney
Cuna
Goajiro
Guaymi
Jirajara
Lenca
Lucayo
Miskilo (Mosquito)
Motilones
Sub-Taíno
Taíno
Tairona

*Has a separate article in *World Book*.

clothing of netting. The Caribbean Indians created excellent pottery and shaped gold and copper into a variety of ornaments and tools. Their weapons included spears and spear throwers, slings, clubs, and blowguns. Some tribes also used the bow and arrow.

The Caribbean Indians had elaborate religious beliefs and practices. Many worshiped tribal gods in the form of idols called *zemis*. The idols were made of such materials as bone, wood, or gold. The people had zemis in their homes, but the chief kept his in a temple. The people often made offerings to the chief's zemis, which they believed to be particularly powerful. Tobacco—either smoked or inhaled as snuff—was used in religious ceremonies.

After European contact. Columbus explored the Caribbean region on his four voyages, and Spanish explorers followed him. Thus, the Caribbean people were the first Indians to come into permanent contact with Europeans. The diseases brought by the Europeans killed many Indians, and many more died as slaves. Whole tribes were wiped out, and others fled to remote areas to escape the white people.

Soon, only a few Indian groups remained. But even these no longer lived as they had before the whites arrived. Food was not so plentiful as it once had been, because the Europeans had driven the Indians onto poor land. The Indians no longer made pottery or wove cloth. They used whatever European manufactured goods they could afford. Their religion became a combination of the Roman Catholic faith and their earlier beliefs. Little of the Caribbean Indians' original way of life remains today.

American Museum of Natural History, New York City (WORLD BOOK photo by Lee Boltin)

Crafts of the Caribbean Indians included pottery that had three legs and featured the jaguar and other animals. Gold was cast into images of birds and frogs that were worn as pendants.

Indians of the Andes

The Andean Indians lived in the highlands of the Andes Mountains of South America and in nearby coastal areas. This large region includes southwestern Colombia, central Ecuador, coastal Peru, most of Chile, and parts of western Bolivia and Argentina. More Indians lived in the Andes than in any other region of the Western Hemisphere.

Before European contact. Human beings settled in the Andes possibly as early as 15,000 years ago. Later, these early peoples tamed llamas, fished, and cultivated some crops, particularly potatoes. By 2000 B.C., enormous ceremonial centers were being built along the coast of Peru.

From about 800 to 400 B.C., Chavín de Huantar, in Peru's north-central highlands, became a great center of religious pilgrimage. The influence of the Chavín civilization spread throughout the Andean world. Later, the Nazca, the Moche, and other cultures developed in

Drawing by F. Caycho; Photo by G. Reparez

A Moche wallpainting from a ceremonial center uncovered in northwestern Peru showed a ritual known as the *sacrifice ceremony*. In this ceremony, the Moche killed prisoners and consumed their blood. One of the key figures in the ceremony was a priestess, shown at the far left in this reconstruction of the painting.

The Andes region

Major groups:

*Araucanian	Huari
Atacama	*Inca
Aymara	Lipe
Barbacoa	*Nazca
Cañar	*Moche
Cayapa	(Mochica)
Chavín	Tarapaca
Chimu	Tiwanaku
Colorado	(Tiahuanaco)
Diaguita	Uru

*Has a separate article in *World Book*.

Peru. Archaeologists have uncovered spectacular tombs of Moche chiefs in burial mounds near the modern Peruvian town of Chiclayo. The tombs are filled with gold, silver, and other precious objects.

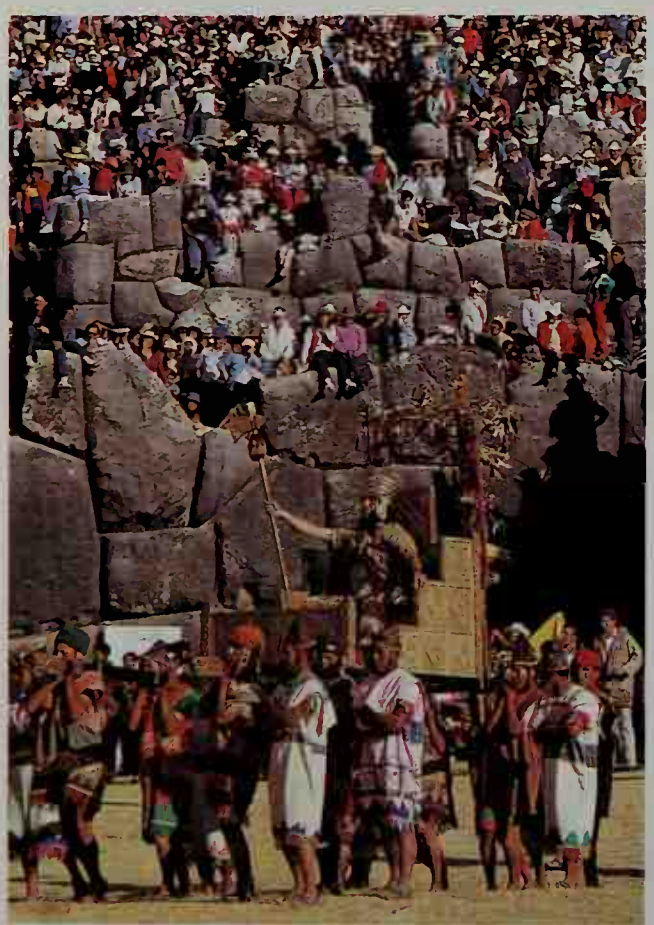
From about A.D. 400 to 900, two powerful Indian societies, the Huari and the Tiwanaku (also spelled Tiahuanaco), directly controlled or influenced much of the vast mountainous territory of Peru and Bolivia. They organized large caravans of llamas to trade with other Indian groups in distant lands. The Huari and Tiwanaku peoples had contact with each other, and scholars believe the two societies were rivals.

From the late 1400's to the early 1500's, the Inca controlled an empire that extended more than 2,500 miles (4,000 kilometers) from southern Colombia to central Chile. The population of the empire numbered between $3\frac{1}{2}$ million and 7 million. The Inca ruled from their capital of Cusco in southern Peru.

Villages of the Inca empire lay scattered about the countryside, and regional rulers lived in the cities. The regional rulers, in turn, were responsible to the emperor. The Inca believed that their emperor was a god and a descendant of the sun god. They expanded their empire by conquering neighboring tribes. The Inca left many conquered local rulers in charge of their own people. These rulers were forced to learn the Inca language. The conquered peoples raised crops for the Inca, built roads and bridges for them, and served in the Inca army.

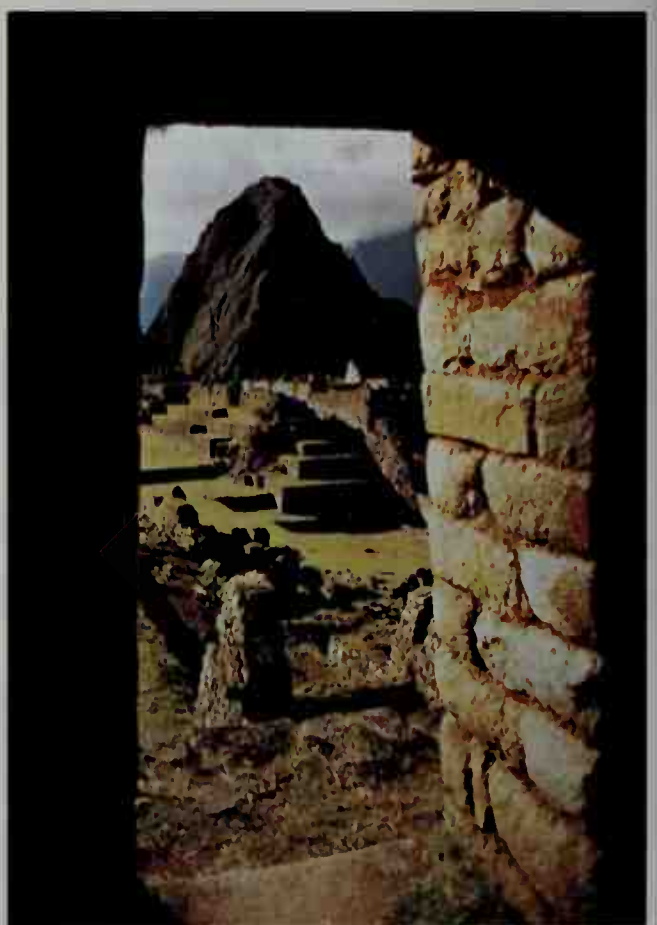
Agriculture flourished in the Andes in spite of the mountainous land. Cultivated plots were terraced on steep hillsides and watered by irrigation systems. The main crops included beans, corn, squash, tomatoes, and white potatoes. Fishing was important along the coast and in the lakes of the region. The Indians ate the meat of the llama and the alpaca. They also used these animals as beasts of burden and as sources of wool. The Andean people wove cotton and the wool of the alpaca and llama into skirts, tunics, breechcloths, and capes.

Skilled craftworkers shaped gold, silver, copper, platinum, and bronze into ornaments and tools, primarily



Robert Frerck, Odyssey Productions

The Inca Indians ruled the largest empire in the New World. The most magnificent of their religious ceremonies—the Festival of the Sun—is reenacted, *above,* at an Inca fortress in Peru.



Claus Meyer, Black Star

The city of Machu Picchu was built by Inca stoneworkers without strong animals or wheeled vehicles to move the heavy boulders. Ruins of the city still stand in the Andes, *above.*

American Museum of Natural History, New York City (WORLD BOOK photo by Lee Boltin)

Crafts of the Indians of the Andes included objects shaped from copper, gold, lead, and silver. The copper knife shown above has a blade that looks like a fish and shell eyes and fins. Weavers in the Andes created magnificent tapestries from alpaca, llama, and vicuña wool and from cotton.

for the ruling class. The Inca also produced excellent pottery.

Inca villages had houses made of stone and adobe. In the large cities, huge public buildings were constructed of large stones. The Inca did not use mortar to bind the stones together. However, they carved the stones so carefully that a knife blade could not be inserted between the stones of a building.

The Inca believed in a creator god as well as moon, earth, and sea gods. Their beliefs and ceremonies centered on rain, the sun, and other forces that affected the growing of food. The Indians kept images of their national gods in temples and held great religious ceremonies there.

After European contact. The Spanish explorer Francisco Pizarro was the first European to see the Andean Indians. In 1532, Pizarro captured the Inca ruler Atahualpa. Rivalry over the throne between Atahualpa and his brother helped Pizarro conquer the Inca empire.

Gold and silver were the main goals of the Spanish conquerors, and they made many farmers work in the mines. Large numbers of Inca died from this forced labor and from diseases brought by the Europeans. The Indians rebelled several times. The last uprising—led by Tupac Amaru, a descendant of an Inca leader—was crushed in 1782.

Today, the Andean region has the largest Indian population in South America. More than 15 million people speak Quechua, which is the Inca language and one of the official languages of Peru.

Indians of the Tropical Forest

Indians of the Tropical Forest lived along rivers and in the jungles that cover almost all of what are now Guyana, Suriname, and French Guiana; much of Brazil; southern Colombia and Venezuela; and eastern Bolivia and Peru. Farming was the main source of food in this hot, humid region.

Before European contact. Most Tropical Forest Indians lived in small villages of related families. However, some Tropical Forest societies were organized as complex chiefdoms. The people of these societies constructed large ceremonial centers and occupied densely populated villages and towns. The most complex societies in the Tropical Forest region developed along the middle and lower Amazon River in Brazil and in the vast lowlands of eastern Bolivia.

Indians of the small villages of the Tropical Forest farmed by the slash-and-burn method, and cassava, the source of tapioca, was their chief food. Cassava roots contained a poisonous substance that had to be removed. The Indians grated and squeezed the roots to remove the poison. Then they ground the remains into meal for making bread or porridge. Other crops included beans, corn, squash, sweet potatoes, and tobacco. Small game and fish also provided food.

Wolfgang Kahler

Tropical Forest Indians in a few areas remain relatively untouched by Western culture. These Bora Indians are performing a traditional dance and wearing bark clothing. The Bora live in the Amazon rain forest in Colombia and Peru and belong to the Witoto group of Tropical Forest Indians.

The Tropical Forest people wore only breechcloths and short, apronlike skirts. But they covered themselves with painted designs and wore jewelry. Their housing was simple, consisting of a pole framework and thatch roof. The sides were left open, and hammocks were often the only furniture. Some tribes built a single large house for the whole village. In other communities, each family had its own house.

Hunters in the jungles used spears, bows and arrows, and blowguns. They fished with nets, hooks, and drugs that stunned fish. Warfare occurred frequently between tribes. The Witoto and Tupinamba were cannibals, and the Jivaro shrunk the heads of captives as trophies.

After European contact. The people of the Tropical Forest did not have much early contact with the Europeans. The explorers and colonists had little interest in either their land or its resources. Later, many Indians went to work on the plantations of the Europeans. This closer contact brought about the usual increased death rate from disease and the gradual decline of Indian ways.

Today, groups of Tropical Forest people still live in South America. They have borrowed some items from the European culture, especially weapons and utensils. Some Indians work on the plantations from time to time or grow such crops as sugar cane and bananas. They sell the crops to buy manufactured goods.

Indians of the Marginal Regions

Indians of the Marginal Regions barely managed to exist on the poor lands of eastern and southern South America. Most of these Indians lived on the plains,

The Tropical Forest area

Major groups:

Amahuaca
Arara
*Arawak
Arua
Camacan
Campa
Carajá
Cariri
Conibo
*Gê:
Bororo
Caingang
Kayapó
Sherente
Timbira
Guaicuru
Guayaná
*Jívaro
Kuikuru
Mojo
Pano
Taulipang
Tucuna
*Tupi-Guaraní:
Chiriguano
Guaraní
Mundurucú
Omagua
Sirionó
Tupina
Tupinamba
Witoto
Yagua
Yanomami

*Has a separate article in *World Book*.

American Museum of Natural History, New York City (WORLD BOOK photo by Lee Boltin)

Crafts of the Tropical Forest Indians included feathered headbands made from the plumes of colorful jungle birds. The oval loom was used to make strips of decorative textiles.

which had little plant or animal life. Those who lived on the cold, rainy coasts also lacked natural resources.

Before European contact. Only small numbers of Indians lived in the Marginal Regions. They roamed about in bands of 50 to 150 people searching for food. Most tribes gathered wild seeds and fruit and hunted small game for food. In the northern area, the Gê-speaking tribes also planted sweet potatoes and yams. In the south, the Tehuelche and Ona relied heavily on such large game as the rhea and guanaco. Along the coast, shellfish were an important source of food. A few tribes lived by rivers and fished from dugout canoes.

The Marginal Regions people had only simple tools. The hunters used a device called a *bola,* which consisted of stone or clay balls attached to the ends of a rope. When thrown at a running animal, the balls of the bola wind the ropes around the animal's legs and make it fall to the ground. The hunters also used bows and arrows, and spears and spear throwers. The people fished with nets, harpoons, spears, and bows and arrows. Most of the tribes did not make pottery. As a result, few families had cooking pots. Most food was roasted directly over the fire.

Most people of the Marginal Regions went naked or wore only brief skin garments, even in cold areas. They decorated their bodies with paint, tattoos, feathers, and ear, nose, and lip ornaments. Some tribes did not build houses of any kind. Others lived in caves or in shelters of branches and brush. Other houses were simple lean-to or pole structures covered with mats or skins.

After European contact. The Europeans had little interest in the Marginal Regions. But enough contact between Europeans and Indians took place to spread disease and change the Indian way of life.

The South American Marginal Regions

Major groups:

Abipón
Alacaluf
Ashluslay
Charrúa
Chono
Guató
Macú
Mataco
Mbayá
Mura
Nambicuara
Ona
Payaguá
Puelche
Querandi
Sirionó
Tehuelche
Yahgan
Zamuco

After the white people brought horses to the plains, some rhea and guanaco hunters adopted a new way of life. These Indians became cowboys, called *gauchos* in South America. But mostly, the Indians of the Marginal Regions either died out or became part of the general population of the country in which they lived.

The destruction of Indian America

The arrival of Europeans in the Americas marked the beginning of the end of the way of life many Indians had known for centuries. Waves of European explorers, fur traders, missionaries, and settlers swept across the New World. Many settlers thought they were superior to the Indians and tried to force Indians to adopt their ways. Missionaries tried to persuade Indians to abandon their

Illustration by Johann Zwecker from *At Home with the Patagonians;* The Newberry Library, Chicago

Swinging their bolas, Indians of the South American plains close in on guanaco and rheas. Some of the Indians of the Marginal Regions became *gauchos* (cowboys) after the white people brought horses into the area. But many of these Indians died from diseases brought by the Europeans.

traditional religions and convert to Christianity.

Land became a major issue between the Europeans and the Indians. The settlers wanted the land for farming, for grazing cattle, and for mining. They believed in the ownership of land. Most Native Americans, on the other hand, generally considered themselves caretakers of the land. They believed that they did not own the land individually and therefore had no right to sell it or give it away. Consequently, when Indians "sold" land, they might believe they were only agreeing to let the whites use it. The Indians expected to keep hunting or farming there. When the settlers tried to keep the Indians off what the settlers now considered their property, fighting broke out. Through the years, more and more Indians were forced off their land as more and more newcomers arrived.

In Canada. During the 1500's, early French explorers claimed eastern Canada for France. The French were interested mainly in establishing trade with the Indians, and the two groups had relatively good relations. Some French traders married Native American women. Their descendants—that is, people of mixed French and Indian ancestry—became known as *métis.*

During the 1600's, English colonists began to move into eastern Canada. They claimed the land for England, and conflicts broke out between the English and the French. Between 1689 and 1763, the French and English fought four wars for control of North America. During these wars, some tribes sided with the French and others with the English. The wars ended with British victories, and as a result, Native American tribes came under British control.

The British government set aside lands for the Indians. In the 1800's, it assigned groups of Indians to reserves. The British Canadians and the Indians generally lived separately, but differences still arose between them. After settlers nearly killed off the buffalo on the Canadian plains, many Indians were left without their chief source of food and clothing. The death of the buffalo and disputes over land claims helped lead to two métis rebellions. They were the Red River Rebellion (1869-1870) and the North West Rebellion (1885), which is sometimes called the Louis Riel Rebellion.

In 1867, Britain passed the British North America Act (now called the Constitution Act of 1867), which created the Dominion of Canada. The new government of Canada continued the earlier policy of confining Indians to reserves. The superintendent general of Indian affairs was placed in charge of the reserves and of government dealings with the Indians. Through the years, superintendents negotiated a number of treaties for western Indian lands.

The Canadian government focused on *assimilating* (integrating) Indians into mainstream Canadian society. Parliament passed legislation calling for elected tribal governments to replace traditional hereditary leadership. Other laws allowed the government to order Indian children to be sent to boarding schools, where they could be taught white customs away from the influence of their families. Laws of the late 1800's banned certain Indian religious practices, including the sun dance.

The Indian Act of 1876 summarized laws concerning who could legally be considered an Indian. People who met the legal definition of Indians were known as *status Indians.* They did not have to pay taxes on reserve property and had certain other privileges. But they could not vote in provincial and federal elections and were denied many other civil rights held by Canadian citizens.

The Indian Act also furthered the government's policy of *enfranchisement.* This policy involved the voluntary rejection by male status Indians of their tribal identity. In choosing to become enfranchised, Indian men gained the right to vote and other privileges held by non-Indians. On the other hand, enfranchised Indians lost their legal and treaty rights as Indians as well as their right to live on a reserve. An Indian woman became enfranchised if she married a non-Indian man. Many Indians opposed enfranchisement, seeing it as a threat to their traditional way of life and their tribal identity. Through the years, relatively few Indians chose to become enfranchised.

In Latin America. Some scholars estimate that from 15 million to 80 million Indians lived in Latin America when white people arrived. The Spanish and Portuguese conquerors soon spread over the land, searching for gold, silver, precious stones, and other riches. Most Caribbean Indians did little to oppose them, and the Europeans quickly overcame the Indians in the highland areas of Central and South America. Hernando Cortés conquered the Aztec in Mexico between 1519 and 1521. In Peru, Francisco Pizarro overturned the Inca empire in the early 1530's.

Other Spanish explorers led expeditions into other areas of Latin America and pushed all the way to the southern tip of South America. Most won relatively easy victories against the Indians. Some Indians, including the Maya of Yucatán and the Araucanian of Chile, fought back. Large numbers of Latin American Indians were killed in warfare or died of diseases carried by Europeans. By 1600, most Indian societies of Latin America had yielded to European control.

During the early 1500's, Spain established the *encomienda* system in Latin America. Under this system, the Spanish king granted colonists the right to collect payments from Indians living on certain large tracts of land. The Spanish landowners forced the Indians to farm the land or work in mines. Eventually, the colonists claimed ownership of the land. Thousands of Indians died from overwork and harsh treatment. Some Indians escaped by fleeing to remote inland areas.

Spanish threats to Indian ways of life were not limited to forcing them to work for the colonists' profit. The Spaniards also weakened traditional tribal bonds by resettling individual members of tribes so that they would have little contact with one another. In some cases, Indians were moved onto *congregaciones,* specially designed villages where the Indians could be taught Christianity and European customs and manners.

During their rule in Latin America, the Spaniards created a class structure based upon race. In general, the Spaniards themselves—the whites—constituted the highest class. *Mestizos* (people of Indian and Spanish descent) and *mulattoes* (people of black and Spanish ancestry) formed the next class. The lowest class was made up of Indians and black slaves.

In the United States. Most of the early English settlers who came to what is now the United States wanted to start new lives and make new homes for their fami-

Drawing by an unknown Aztec artist from *History of the Indies of New Spain* (late 1500's) by Diego Durán; National Library, Madrid, Spain (Granger Collection)

Hernando Cortés of Spain, *holding hat,* conquered the Aztec Indians of Mexico between 1519 and 1521. This drawing shows Cortés approaching a group of Aztec leaders. By 1600, most of the Indian societies of Latin America had come under European control.

lies. At first, the British and colonial governments tried to deal with the Indians through negotiation and treaties. The settlers and the Indians had fairly friendly relations. But as the Indians sought to protect their land from the claims of increasing numbers of newcomers, fighting broke out between the two groups.

After the Thirteen Colonies declared their independence from Britain, the government of the new United States became responsible for dealing with the Indians. In 1778, the United States and the Delaware Indians signed a treaty—the first between the new nation and an Indian tribe. Nearly 400 other treaties followed. In these pacts, tribes typically agreed to keep peace with the settlers and to recognize the jurisdiction of the U.S. government. Each tribe gave up much of its territory and kept only a part for itself. The federal government promised a cash payment and protection in return for the land it obtained from the tribe. In most cases, the government also agreed to supply the Indians with livestock, manufactured goods, and medicine.

Under the U.S. Constitution, treaties with Indian tribes were as legally binding as agreements with other nations. But many of the treaties were broken as increasing numbers of settlers entered lands reserved for the Indians.

The U.S. government saw the need for a special agency to deal with trade, negotiations, and other matters involving Indians. In 1824, it set up the Office of Indian Affairs (now the Bureau of Indian Affairs) and placed it under the control of the War Department. In 1849, the office became part of the Department of the Interior.

Indian removal. In 1830, Congress passed the Indian Removal Act. This act was designed to free more eastern land for white settlement. It allowed the president to move the eastern Indian tribes to land west of the Mississippi River. The Indian land in the West became known as the Indian Territory. This huge reservation spread across what are now Oklahoma and parts of Kansas and Nebraska.

United States military patrols supervised the Indian groups during the westward journey. According to some estimates, the U.S. government had moved more than 70,000 Native Americans across the Mississippi by 1840. Thousands of Cherokee, Chickasaw, Choctaw, and other Indians died on the journey westward.

Treaties with the United States guaranteed the lands of the Indian Territory to the Indians who had moved from the East. Eventually, however, settlers wanted that land as well, and the territory was reduced. Meanwhile, settlers were pushing into other Indian lands in the West all the way to the Pacific Ocean. The discovery of gold in California in 1848 also brought prospectors who killed the game on which many Western tribes depended. The Indians fought to keep their lands but were finally defeated. The U.S. government placed the various tribes on isolated reservations, mainly in the West.

New Indian policies. In 1871, Congress concluded that the tribes were no longer separate, independent governments. This action freed the United States from the need to make treaties with the Indians. Then, in 1887, Congress passed the Dawes Act, also called the General Allotment Act, to break up tribal lands into small property units. In general, each eligible head of an Indian household received a parcel of 160 acres (65 hectares). Most single Native Americans received 40 or 80 acres (16 or 32 hectares). Land that remained after all the Indians had received their shares was sold to whites, there-

The Trail of Tears (1942), an oil painting on canvas by Robert Lindneux; Woolaroc Museum, Bartlesville, Oklahoma.

The forced migration of eastern U.S. Indians to territory west of the Mississippi River followed passage of the federal Indian Removal Act of 1830. Thousands of Indians died on the way.

by freeing more land for white settlement.

Through the Dawes Act, the government hoped to encourage the Indians to become farmers. The government also hoped to assimilate them into non-Indian society. But many Indians had no knowledge of farming, and others had no interest in it. Also, much of the land allotted to the Indians was unsuitable for growing crops. As a result, many Indians sold their lands and lived off the money they received. When that money ran out, the Indians had no means of support. Some white people settled illegally on Indian lands, and the government had difficulty evicting the intruders. In addition, many Indians were cheated out of their land by corrupt land speculators.

Indians in the early and mid-1900's

In Canada. During the early 1900's, Canadian Indians and métis continued to lose land to settlers and to lack equal rights. In 1951, Parliament passed another Indian Act, which primarily restated previous policy. In 1985, the act was amended so that Indian women would no longer automatically forfeit their Indian status if they married non-Indian men.

In 1966, Parliament established the Department of Indian Affairs and Northern Development (DIAND). The department was designed to supervise and promote economic and political development of native lands. It was also supposed to administer the Indian Act with federal funds and programs. Through the years, DIAND's role has expanded to include the supervision of such matters as Indian treaty claims, environmental protection, and management of natural resources.

Since the late 1960's, several national organizations have worked to promote Indian, Inuit, and métis land claims and civil rights. They have sought to develop new political relationships with the Canadian and provincial governments. These groups include the Assembly of First Nations, the Inuit Tapirisat of Canada, the Métis National Council, and the Native Council of Canada.

In Latin America, much of the political and economic power lay in the hands of the large landowners. During the early to mid-1900's, Latin American Indians engaged in protests and armed uprisings to demand social, political, economic, and land reform. In Mexico, for example, many Indians joined mestizo leader Emiliano Zapata in fighting the government in the early 1900's. Indians also took part in reform movements in Bolivia, Chile, Peru, and other countries. These movements succeeded in breaking up some large estates and dividing the land among Indians. Despite such successes, however, most Indians continued to live in poverty and to lack political rights.

During the early years of the European colonization of Latin America, some Indians had retreated to remote inland areas. There they largely kept their old ways of life and had little contact with the Europeans. However, as the countries of Latin America expanded during the 1900's, settlers started moving into areas that whites had previously not wanted. They cleared the land for farms, dammed rivers for hydroelectric power plants, and

cut down the rain forest for lumber. All these actions threatened Indian lands and culture.

In the United States, the federal policy of land allotment to individual Native Americans remained in effect during the early 1900's. In general, the allotment policy and other government programs aimed at assimilating Indians into the U.S. mainstream. For example, many Indian children were sent to boarding schools away from their homes where they were not allowed to practice Indian customs or speak Indian languages. The Bureau of Indian Affairs (BIA) also banned certain religious ceremonies.

Citizenship. Before the 1920's, members of certain tribes had acquired U.S. citizenship through treaties. Other Indians received it by procedures established in the Dawes Act and its amendments. In 1924, Congress passed the Indian Citizenship Act, which gave citizenship to every Indian born within the territorial limits of the United States. Indians who live on reservations pay most federal and state taxes, but they pay no taxes on reservation lands and property or on income earned from them. Indians outside reservations pay the same taxes as other citizens do. All Indians have full voting rights.

The Indian Reorganization Act of 1934. By 1900, the Indian population in the United States, which may have been between 10 million and 15 million before contact with the Europeans, had declined to a low of about 250,000. Most Indians lived on reservations by the early 1900's, and many were poverty-stricken and in poor health. From 1926 to 1928, statistician Lewis Meriam directed a national study of these Indian conditions. The results of the study, known as the Meriam Report, strongly recommended the end of allotment as a way of improving living conditions for Indians. The report called for a new policy that would reemphasize tribal communities and tribal governments.

In response to the Meriam Report, Congress passed the Indian Reorganization Act of 1934. This legislation restored tribal ownership of unallotted reservation lands and prohibited further allotments. It set up a credit fund for economic development. It also encouraged reservation Indians to take a more active role in managing their affairs. The legislation provided for limited self-government through tribal councils elected by the adults of a tribe and overseen by the BIA. These councils direct many of the tribe's activities and represent it in dealings with local, state, and federal governments.

In 1944, Indian leaders founded the National Congress of American Indians to provide a strong Indian voice on Native American affairs. This group became the most important national all-Indian political organization in the United States.

During World War II (1939-1945), about 25,000 Native Americans served in the military and over 50,000 worked in war industries. After the war, many Indians discovered that they no longer fit into their traditional communities. In 1952, the federal government created a relocation program (now called the Employment Assistance Program) to help Indians relocate to cities and adjust to city life.

The termination policy. In 1953, Congress passed a resolution that called for ending federal support and protection of certain Indian tribes. The policy, called *termination,* was designed to absorb Indians into non-Indian culture. In most cases, however, termination took place too quickly and with too little preparation for independence. Also, Native Americans faced discrimination within the mainstream culture. Eventually, opposition to the termination policy caused the government to abandon it. Many of the tribes that had been "terminated" under the policy then campaigned to regain their official tribal status.

The push for Indian rights. During the 1960's and 1970's, some Indian groups began to urge Indians to be more forceful in seeking economic and political equality. In 1968, the American Indian Movement (AIM) was founded to work for equal rights and better living conditions for American Indians. Since its founding, AIM has held a number of protests and take-overs. In 1972, for example, AIM and other Indian-rights groups took over the BIA building in Washington, D.C. The protesters' demands included a review of U.S. treaty violations and the establishment of improved educational and economic programs.

Several other national Indian groups were formed during the 1960's and 1970's. They included the Native American Rights Fund, which furnishes legal aid to protect Indian lands and resources; the National Indian Education Association, which works to provide better education for Indian students; and the Council of Energy Resource Tribes, which promotes good management of oil and other energy resources.

The U.S. government addressed some Indian concerns through legislation, executive orders, and court decisions. In 1971, for example, Congress passed the Alaska Native Claims Settlement Act, which gave money to the state's native peoples and settled land claims, reserving about 40 million acres (16 million hectares) for these peoples. President Richard M. Nixon issued an executive order for the return of Mount Adams and other lands to the Yakima of Washington in 1972.

In 1978, Congress approved a land settlement for the Narragansett tribe of Rhode Island. The tribe received 900 acres (360 hectares) taken from their ancestors and funds to purchase a remaining 900 acres (360 hectares) from private owners.

In 1980, the Administration of President Jimmy Carter negotiated a settlement with the Penobscot, Passamaquoddy, and Maliseet, who had sued to recover nearly two-thirds of Maine. The Indians agreed to drop their lawsuit in exchange for an $\$81\frac{1}{2}$-million settlement. Two-thirds of the money would be used to purchase a "permanent land base" for the tribes.

In 1980, the Supreme Court of the United States ordered the federal government to pay about $105 million to eight tribes of Sioux Indians. The money was payment for Indian land in South Dakota that the government seized illegally in 1877. The tribes refused the settlement and sought the return of part of the Black Hills in South Dakota as well as a cash payment.

Native Americans today

About 45 million Indians live in Latin America. Millions more are part Indian. More than half the people in a number of Latin American countries, including Bolivia, Ecuador, Guatemala, Mexico, and Peru, are Indians or have mixed ancestry. About 550,000 Canadians are

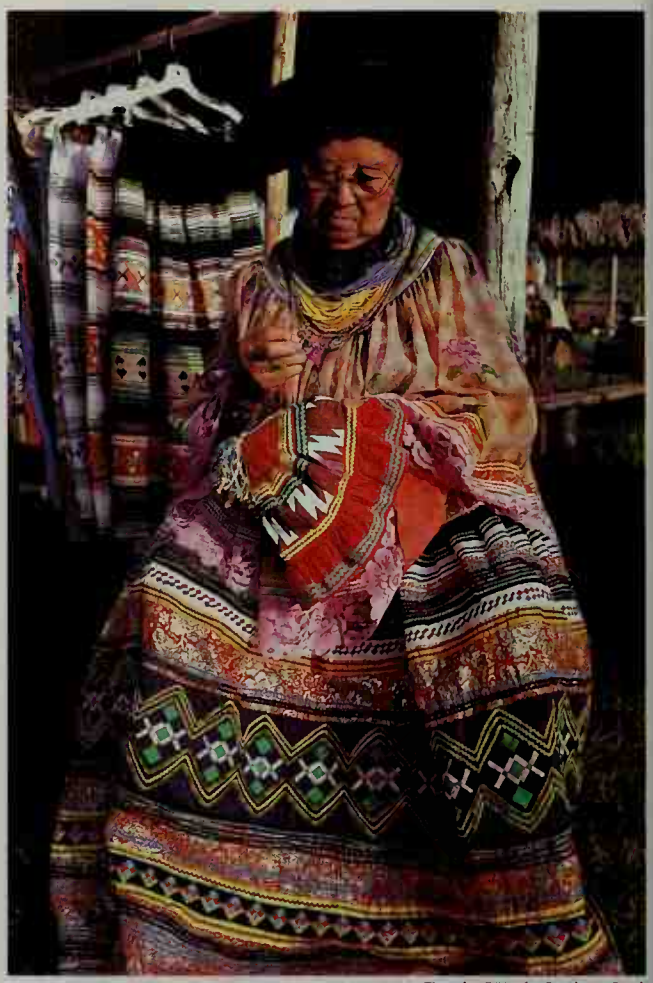
registered as Indians by the Canadian Department of Indian Affairs and Northern Development.

About 2 $\frac{1}{2}$ million Native Americans live in the United States. The largest of the more than 540 American Indian tribes include the Cherokee, Chippewa, Choctaw, Navajo, and Sioux. About a third of the Indians in the United States live on reservations, traditional tribal lands, and other designated areas. About three-fifths make their homes in urban areas.

The preservation of Indian culture. Tribal culture remains relatively strong on reservations, where many Indians continue to practice ancient traditions. Nevertheless, many Native Americans worry that assimilation into the mainstream society will lead to a loss of Indian identity and traditional Indian ways. They point, for example, to the decline in the number of people who speak Native American languages. When Europeans arrived in North America, at least 300 languages were spoken by Indians in what is now the United States and Canada. Today, fewer than 200 languages are still spoken, and many of them are used little or only by a few older members of a tribe. Only about 40 of the languages are spoken by people of all ages, including children.

The movement of Indians from reservations to urban areas has also had a major impact on the social structure of Indian communities. A large number of Indians no longer depend on the community, as they once did, for help and support. Instead, they see themselves as individuals rather than as members of a community, and they have become more self-reliant. In addition, the small nuclear family—consisting of a father, a mother, and their children—has replaced the larger network of extended families and clans as the major social unit.

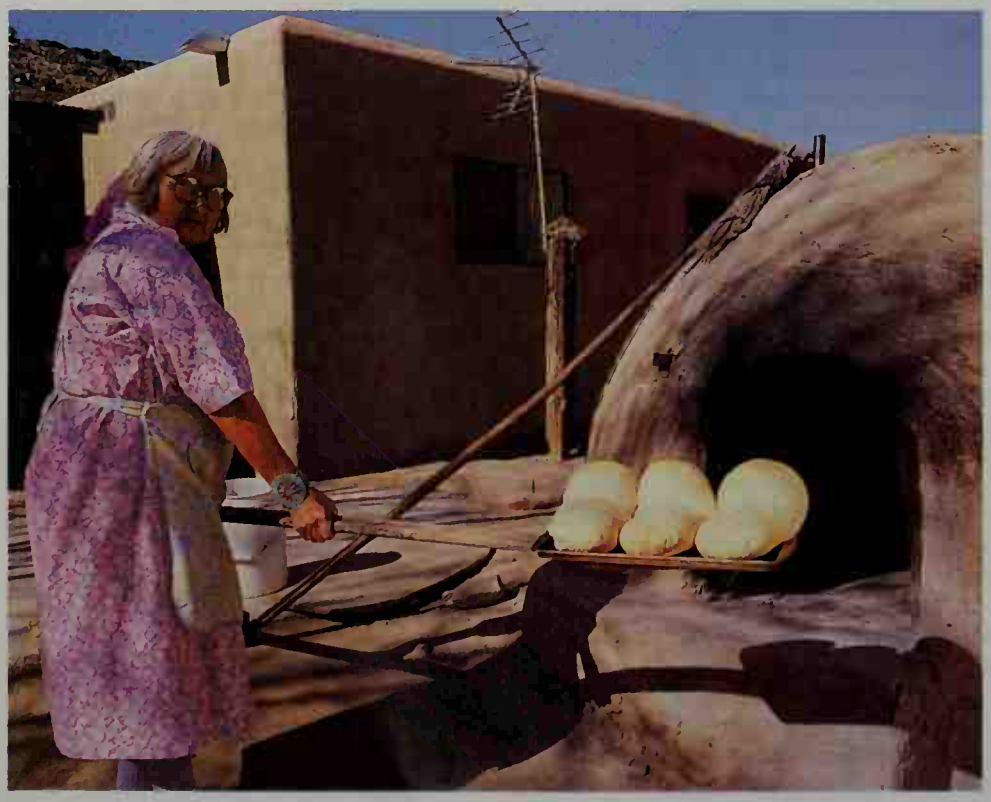
Social and economic progress for Indians has been made since the mid-1900's. Gains in education, in partic-



Timothy O Keefe, Southern Stock

Indian craftwork is a source of income and a way of preserving Native American culture. This Seminole woman is sewing traditional tribal clothing similar to the garments she wears.

© David R. Frazier



Indian reservations are home to about a third of all American Indians in the United States. Many Indians who live on reservations follow their tribe's traditional way of life. This Pueblo woman, for example, is baking bread in a traditional outdoor oven.

ular, have provided Native Americans with better economic opportunities. In the 1960's, American Indians averaged about 8 $\frac{1}{2}$ years of formal education. Today, the majority of Indian young people graduate from high school, and about 9 percent of all Indians 25 years of age and older have a college degree. The number of Native Americans who have entered law, medicine, and other professional fields has also increased. Since the 1980's, a middle class of Indian professionals has emerged.

The economic situation of American Indians has improved for other reasons as well. During the mid-1970's, federal funding aided tribes in starting their own companies. In addition, some tribes invested money won from land claim settlements into economic development. Today, a number of tribes operate successful industries. For example, the Navajo make electronic parts for missiles; the Choctaw manufacture parts for automobiles; and the Cherokee produce a variety of horticultural products.

Gambling casinos, authorized by the Indian Gaming Regulatory Act of 1988, are an important source of revenue for many tribes. Gambling operations on reservations have also provided a large number of jobs for Indians and aided other businesses, such as tourism and craftwork.

Some tribes get money by leasing rights to or taxing the production of oil, natural gas, and other minerals on their reservations. The Council of Energy Resource Tribes works to protect tribal interests in the use of natural resources on reservations. The lands of the more than 40 tribes in the United States that belong to the council are rich in coal, uranium, and other fuels.

In spite of the social and economic advances of Indians, many problems remain. Unemployment on reservations in the United States averages 40 to 60 percent, and the average income per Indian family is significantly lower than the national average. Most Indians in the work force hold low-paying, unskilled jobs. Suicide and infant mortality rates are higher, and life expectancy is lower among Native Americans than among the population of the United States as a whole. Alcoholism is also a problem.

Native Americans often struggle to balance their traditional regard for the environment with their need for economic development. For example, tribes whose lands are rich in mineral resources face the question of how much mining can be done on their land without permanently damaging it.

Achievements in the arts. A number of Indian writers have won widespread acclaim for their works. In 1969, N. Scott Momaday, a writer of Kiowa and Cherokee ancestry, became the first Native American to win the Pulitzer Prize in literature. He was honored for his novel *House Made of Dawn.* Other Native American authors of note include Sherman Alexie, a Spokane and Coeur d'Alene Indian; Michael Dorris, who was Modoc; Louise Erdrich, who is Chippewa; Thomas King, who is Cherokee; Leslie Marmon Silko, who is Pueblo; and James Welch, who is of Blackfeet and Gros Ventre descent.

Maria Martinez, a Pueblo Indian, revived pottery making as a fine art among the Pueblo of the Southwest. A large number of people also prize such Indian craftwork as jewelry, finely woven rugs and blankets, and baskets. Indians also hold gatherings called powwows each year

Grand Casino

Gambling casinos have opened on many reservations since they were authorized by the federal government in 1988. These operations provide many tribes with an important source of income. The Chippewa operate this casino in Hinckley, Minnesota, on the Mille Lacs Reservation.

Acrylic on canvas; Heard Museum, Phoenix, Arizona (© Jerry Jacka)

Red-Tailed Hawk, a painting by Pueblo Indian artist Dan Namingha, is an example of fine art produced by Native Americans in the late 1900's. The painting, dated 1985, uses modern materials and techniques to present a traditional American Indian subject.

in a number of cities, including Chicago and Denver. Modern powwows are more festive versions of the traditional tribal meetings held to discuss problems. They feature Indian dancing, singing, and displays of arts and crafts.

Political gains. Native Americans have had little representation in United States politics. There are some notable exceptions, however. Charles Curtis, whose mother was part Kaw (Kansa) Indian, served as vice president of the United States from 1929 to 1933 under President Herbert Hoover. Benjamin Reifel, a Sioux, served as a United States congressman from South Dakota from 1961 to 1971. In 1977, Forrest Gerard of the Blackfeet tribe took the newly created office of assistant secretary of the interior for Indian affairs. In 1993, Ben Nighthorse Campbell, a Northern Cheyenne from Colorado, became the first Native American to hold a United States Senate seat since Curtis, who had been a senator before he became vice president. Also in 1993, President Bill Clinton appointed Ada E. Deer, who is Menominee, to become the first woman assistant secretary for Indian affairs.

Despite the shortage of Indian political leaders, Native Americans have lobbied successfully to have Congress enact some favorable legislation. In 1975, Congress passed the Indian Self-Determination and Education Assistance Act. This act allows tribes to assume administrative control over federally funded Indian programs. As a result, tribes could take over from the federal government management of their own community development, education, health, housing, and law enforcement programs.

The government has also expanded its recognition of the cultural identity of Indian tribes. A congressional resolution known as the American Indian Religious Freedom Act of 1978, for example, recognized the importance of Native American religions. The act declared that Indians should have the same right to the free exercise of religion as other citizens have under the Constitution.

Current issues facing the various native peoples of North and South America are similar. Indians continue to work to improve their economic, social, and political position and to protect the lands and rights guaranteed to them by treaty. They also seek respect for their cultural heritage.

In Canada, Indians have continued their push for self-government and their efforts to protect their land. In 1990, for example, armed Mohawk Indians in Quebec became involved in a long stand-off with police and Canadian armed forces. The dispute erupted over plans to expand a city-owned golf course onto what the Indians considered their ancestral burial grounds. The Canadian government eventually offered to turn the disputed land over to the Mohawk.

In 1991, the government proposed a plan to revise the Canadian constitution. Largely because of the efforts of Indian, Inuit, and métis organizations, the plan included a provision for self-government for Canada's native peoples.

In 1992, voters in the Northwest Territories agreed on boundaries for a self-governing homeland for the Inuit in the eastern part of the territories. In 1993, the Canadian government passed legislation to create the new Inuit-controlled territory, called Nunavut. Nunavut came into existence on April 1, 1999. In 2000, the Canadian government approved a treaty with the Niaga'a people of British Columbia, giving them land and the power of self government.

In Latin America, many countries have tried to improve Indian welfare. However, disputes have arisen between Indians and the governments of several Latin American countries. Government leaders frequently complain that the Indians lack respect for national policies. The Indians charge that the governments allow their lands to be damaged by agriculture, industry, or mining. In some cases, the disputes have erupted into violent clashes between Indians and government forces. The most serious conflicts have occurred in Guatemala. Thousands of Indians there died in the 1980's and 1990's, and thousands of others fled to refugee camps in Mexico. Rigoberta Menchú, a Maya Indian, won the 1992 Nobel Peace Prize for her efforts to gain equal rights for Guatemala's Indians.

Beginning in 1987, gold prospectors poured into the Amazon rain forest of northwestern Brazil. This region was inhabited by Yanomami Indians, one of the last Indian tribes whose culture remained relatively unchanged by contact with Westerners. Like the early Spanish explorers, the prospectors brought with them a variety of deadly diseases for which the Yanomami had no immunity. More than 1,000 Yanomami died. In addition, the miners began destroying the rain forest, where the Yanomami hunt and gather food. They also polluted the rivers and streams where the Yanomami fish. In 1990, the Brazilian government began efforts to drive the prospectors out of the region.

In 1994, armed Indian rebels from the Zapatista National Liberation Army seized and briefly held several towns in the Mexican state of Chiapas. The rebels, calling themselves Zapatistas after the mestizo leader Emiliano Zapata, demanded economic and political reform. They accused the Mexican government of ignoring the Indians and called for economic aid and land reform. Government troops quickly drove the rebels from the towns. The Zapatistas retreated to jungle areas of Chiapas, and the government declared a cease-fire.

In the United States, Native Americans continue to work for self-determination—that is, the right to control their own land and their own affairs without interference from the BIA or other federal agencies. Tribes are seeking to guard their hunting and fishing rights. They are working to control mining and similar operations on their lands. They are trying to protect their lands and waters from pollution. Many tribes are also going to court to regain lost lands or to receive payment for them.

Another goal of Native Americans is to have non-Indians view them as living people and not according to false, preconceived, or oversimplified beliefs. For example, many Indians object to the use of Indian names and mascots for sports teams. They say the use of such names and mascots is racist and promotes notions of Indians as "fierce" and "warlike." During games, many sports fans paint their faces, wear headdresses, and sing what they consider Indian songs or chants. These practices, say some Native Americans, insult Indians and their religions. Indians paint their faces in a certain way for religious ceremonies, regard headdresses of eagle feathers as sacred, and use songs as a major part of religious rituals. Some Indians, however, feel that Indian names and mascots honor Native Americans.

Reuters/Bettmann

Protest marches have called attention to Indian concerns. These Kayapó Indians of Brazil are protesting the proposed construction of dams that they say threaten their way of life.

Many Native Americans have called for the return to tribes of Indian skeletal remains and artifacts currently kept in museums. Indians argue that the remains of their ancestors deserve a proper burial and should not be considered specimens for research or public display. They maintain that many of the artifacts are sacred and belong with Native Americans who will show them the appropriate reverence and respect.

To address the issue of the ownership of Indian remains and artifacts, Congress passed the Native American Graves Protection and Repatriation Act of 1990. This act requires institutions receiving federal money to return human remains and any artifacts found with them to the tribes that want them. However, the tribes must prove that they have a valid claim to the remains and artifacts.

Donald L. Fixico, Alan L. Kolata, and Sharlotte Neely

Related articles. There are articles in *World Book* on many of the Indian groups listed in the tables with this article. See also the sections on *Places to visit* and on *History* in the various state and province articles, and the following articles:

Biographies

Atahualpa
Black Hawk
Black Kettle
Brant, Joseph
Campbell, Ben Nighthorse
Captain Jack
Cochise
Cornplanter
Cornstalk
Crazy Horse
Crowfoot
Cuauhtémoc
Deloria, Vine, Jr.
Dorion, Marie
Gall
Geronimo
Hiawatha
Johnson, Pauline
Joseph, Chief
Little Turtle
Logan

Manuelito
Massasoit
McGillivray, Alexander
Menchú, Rigoberta
Montezuma II
Osceola
Parker, Ely S.
Philip, King
Picotte, Susan La Flesche
Pocahontas
Pontiac
Popé
Poundmaker
Powhatan
Quanah
Red Cloud
Red Jacket
Rogers, Will
Ross, John
Sacagawea
Samoset
Sequoyah
Shawnee Prophet
Sitting Bull
Spotted Tail
Squanto
Tallchief, Maria
Tecumseh
Thorpe, Jim
Uncas
Washakie
Watie, Stand
Winnemucca, Sarah
Wovoka

Daily life

Arrowhead
Buffalo (animal)
Hogan
Moccasin
Peace pipe
Pemmican
Sculpture (Indian sculpture of the Americas)
Tepee
Tomahawk
Trading post
Travois
Wampum
Wigwam

Religion

Buffalo ceremonials
Dance (Religious dances)
Ghost Dance
Kachina
Mythology (American Indian mythology)
Rain dance
Sand painting
Shaman
Snake dance
Sun dance
Totem

History

Anasazi
Black Seminole
Cibola, Seven Cities of
Colonial life in America
Copán
Five Civilized Tribes
Folsom point
French and Indian wars
Indian Territory
Indian wars
Mission life in America
Mogollon
Monte Albán
Mound builders
Pioneer life in America (Pioneers and Indians)
Tenochtitlan
Teotihuacán
Trail of Tears
Tula
Western frontier life in America
Westward movement in America
Wounded Knee

Other related articles

American Indian Movement
Brazil (picture: Indians)
Ethnic group
Hampton University
Indian Affairs, Bureau of
Indian Claims Commission
Indian reservation
Latin America
Minority group
Music (American Indian music)
National Congress of American Indians
Racism
San Blas Indians

Questions

How long ago did the first Indians probably come to America? Where did they come from?
Where was the Inca empire? What happened to it?
Why did the life of Plains Indians change after the coming of white people?
What was *wampum?* What was it used for?
When was the Indian Removal Act passed? What was the effect of this act? How did this act reflect attitudes of whites toward Native Americans?
What crops did Native Americans introduce to white settlers? Which of these crops remain part of North and South American culture today?
What is the *spirit power?* The *great spirit?* A *guardian spirit?*
What is *enfranchisement?* Why have relatively few Indians chosen to become enfranchised?
What was the Iroquois League? Why was it formed? When did it begin to split?
Why do many Native Americans object to the use of Indian names and mascots for sports teams?

Additional resources

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Sturtevant, William C., and others, eds. *Handbook of North American Indians.* Smithsonian Institution, 1978-. Multivolume work.

Indian Affairs, Bureau of (BIA), is an agency of the United States Department of the Interior that works mainly to promote the welfare of the nation's Indians. The BIA also supports efforts of Alaskan natives to become self-sufficient and develop their natural resources. Alaskan natives include Inuit (also called Eskimos) and Aleuts as well as Indians.

The BIA is chiefly responsible for Indians who live on or near reservations and other federal trust lands. On some reservations, the bureau enforces the law, provides welfare for the needy, and runs the school system. On other reservations, tribal governments have taken over many or all of these responsibilities. Through the tribes, the BIA assists with job training programs. In addition, the bureau serves as trustee for land and money held in trust by the U.S. government.

The Bureau of Indian Affairs is headed by an assistant secretary of the interior, who is appointed by the president and confirmed by the Senate. The BIA is responsible for about 550 federally recognized tribes, including about 220 communities of Alaskan natives. It has headquarters in Washington, D.C., and is represented on reservations by superintendents or area directors.

The Bureau of Indian Affairs was established in 1824 as part of the War Department. In 1849, the bureau became an agency of the Department of the Interior. At first, the BIA maintained strong control over the lives and property of reservation Indians. It often leased mineral, water, and other rights on the reservations to non-Indians. The tribes had almost no voice in BIA policies.

The bureau's activities grew when Congress passed the Indian Reorganization Act of 1934. This act attempted to establish a policy of self-government for Indians. However, many tribal communities mistrusted government programs after the failure of an earlier policy of breaking up tribal lands into individual property units. That policy had been established by the Dawes Act of 1887.

During the late 1900's, Indians increasingly demanded their rights, and the BIA moved to a policy called *self-determination.* Congress passed the Indian Self-Determination and Education Assistance Act of 1975 to enable tribes and Alaskan native groups to make many important decisions affecting their communities. In the 1970's, 1980's, and 1990's, many tribes and Alaskan na-

AP/Wide World

The Bureau of Indian Affairs (BIA) is an agency of the U.S. Department of the Interior that works to promote the welfare of Native Americans. Here, a BIA official and member of the Pawnee tribe testifies before Congress on the breakup of tribal lands.

tives assumed control of their own schools, law enforcement, courts, and other activities. Donald L. Fixico

See also **Indian reservation** (History).

Indian bean. See Catalpa.

Indian Claims Commission was an independent commission of the United States government. It operated from 1946 to 1978. The Indian Claims Commission heard and decided claims against the government made by any group of American Indians living in the United States. The claims asked for compensation for fraud or for unfair treatment on the part of the federal government. Such claims are now handled by the United States Court of Federal Claims.

The Indian Claims Commission consisted of five commissioners appointed by the president. The Senate approved the appointments. Decisions by the commission could be appealed to a federal claims court and were subject to review by the Supreme Court of the United States. Congress appropriated money to pay the claims. During its existence, the Indian Claims Commission handled nearly 550 claims and awarded about $818 million in damages. Merwyn S. Garbarino

Indian Desert. See Thar Desert.

Indian fig. See Prickly pear.

Indian Guides. See Y-Indian Guides.

Indian hemp. See Dogbane.

Indian mallow. See Velvetleaf.

Indian National Congress. See India (Rise of Indian nationalism).

Indian Ocean ranks as the third largest ocean in the world. The Indian Ocean is less than half the size of the Pacific Ocean and is about one-fifth smaller than the Atlantic Ocean.

The Indian Ocean is bordered by Australia and Indonesia on the east and Africa on the west. Asia lies to the north and the Southern Ocean to the south. India and Sri Lanka divide the northern Indian Ocean into the Arabian Sea and the Bay of Bengal. The Red Sea and the Persian Gulf are also considered part of the Indian Ocean.

A wide variety of animals live throughout the Indian Ocean, especially in the Red Sea, the Persian Gulf, and along coastal waters. Most ocean animals depend—directly or indirectly—on microscopic organisms called *phytoplankton* for survival. These organisms are especially abundant near northern India and in the Persian Gulf. Ocean animals eat the phytoplankton or animals that feed on them.

Pollution is increasing in the Indian Ocean from metal and chemical products, sewage, petroleum, and food-processing waste. In addition, the Persian Gulf suffered severe oil pollution as a result of the Persian Gulf War of 1991. Iraq dumped an estimated 465 million gallons (1.75 billion liters) of Kuwaiti crude oil into the gulf. The United Nations Regional Seas Programme and other international organizations are studying ways to combat pollution in and around the Indian Ocean.

Boundaries and size. The Atlantic and Indian oceans meet off the southern tip of Africa. Australia and the Sunda Islands of Indonesia divide the Indian and Pacific oceans. The southern boundary of the Indian Ocean is 60° south latitude, where the Southern Ocean begins.

The Indian Ocean covers about 26,600,000 square miles (69,000,000 square kilometers). Its average depth is 12,600 feet (3,840 meters). The Indian Ocean drops to its deepest known point in the Java Trench, which plunges 23,812 feet (7,258 meters). The Indian Ocean's greatest width spans about 6,200 miles (10,000 kilometers) between Africa and Australia. The longest north-south distance in the Indian Ocean measures about 5,500 miles

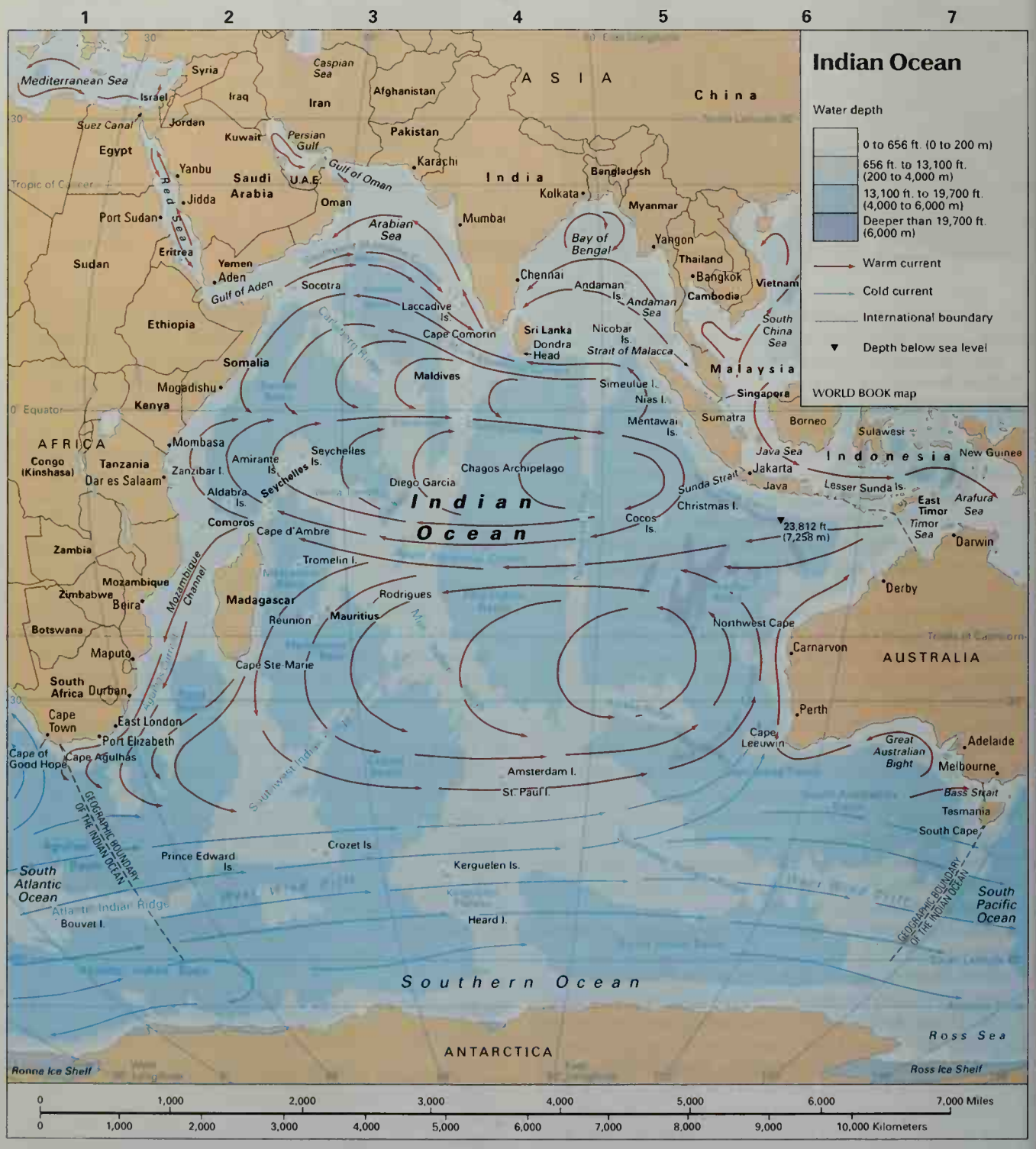
Facts in brief

Area: About 26.6 million square miles (69 million square kilometers).
Greatest distances: *North-south*—about 5,500 miles (9,000 km). *East-west*—6,200 mi. (10,000 km).
Average depth: 12,600 ft. (3,840 m).
Greatest depth: 23,812 ft (7,258 m), in Java Trench.
Surface temperatures: *Highest*, 90 °F (32 °C), in Persian Gulf and Red Sea during July. *Lowest*, below 30 °F (-1 °C), near the Southern Ocean during July.
Tides: *Highest*—36 ft. (11 m), Collier Bay, Australia. *Lowest*—2 ft. (60 cm), near Fremantle, Australia.

(9,000 kilometers) and extends from Pakistan to the Southern Ocean.

Ocean floor. The part of the ocean floor that borders the continents is called the *continental shelf.* The continental shelf stretches for up to 124 miles (200 kilometers) into the Indian Ocean. Around Africa, Asia, and Australia, the continental shelf slopes gently to an average depth of 460 feet (140 meters).

Beyond the continental shelf, the ocean floor becomes rugged, consisting of mountain ranges, broad plateaus, and deep basins. A mountain range called the Mid-Indian Ridge runs through the center of the Indian Ocean. The ridge begins in the Gulf of Aden and separates into two parts at about 25° south latitude. Plateaus



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Agulhas Current ..... E 2
Arabian Basin ..... B 3
Broken Ridge ..... E 5
Carlsberg Ridge ..... B 3
Crozet Basin ..... F 3
Diamantina Trench ..... E 6
Equatorial Countercurrent ..... C 3
Java Trench ..... D 6
Kerguelen Plateau ..... F 4
Madagascar Basin ..... E 3
Mascarene Basin ..... D 2
Mid-Indian Basin ..... D 4
Mid-Indian Ridge ..... E 4
Natal Basin ..... E 2
Ninetyeast Ridge ..... D 4
North Equatorial Current ..... C 4
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South Equatorial Current ..... D 3
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Southwest Indian Ridge ..... E 3
Southwest Monsoon Current ..... B 3
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in the Indian Ocean may rise more than 10,000 feet (3,050 meters) above the ocean floor. Basins may drop more than 16,400 feet (5,000 meters) below the water's surface.

According to the theory of *plate tectonics,* scientists believe the Indian Ocean began to form about 200 million years ago. At that time, a single, huge land mass called Pangaea began to break up into the world's continents. The continents gradually drifted toward their present location. India broke away from Antarctica and Australia as early as 130 million years ago and moved north at a rate of a few inches per year. About 45 million years ago, India collided with Asia. India's northward movement created scars and ridges on the present Indian Ocean floor. See **Plate tectonics.**

Temperatures. Surface water temperatures in the Indian Ocean vary with the seasons and distance from the equator. But the ocean's tropical waters do not reach the same temperature extremes found in the Atlantic and Pacific oceans.

Part of the Indian Ocean lies in the Northern Hemisphere and part in the Southern. The occurrence of the seasons is reversed in the two hemispheres. In January, surface temperatures in most of the Northern Hemisphere part of the ocean range between 70 and 80 °F (21 and 27 °C). They vary from 80 to 85 °F (27 to 29 °C) in most of the ocean's Southern Hemisphere. July surface temperatures in parts of the Northern Hemisphere may reach 90 °F (32 °C). Southern Hemisphere temperatures in July may fall below 30 °F (-1 °C) near the Southern Ocean.

Currents and tides. The movement of the wind determines the direction of currents in the Indian Ocean. *Monsoon winds,* or seasonal winds, cause currents above the equator to move east in the summer and west in the winter. In the Southern Hemisphere, currents are driven west along the equator by steady ocean winds called *trade winds.* The currents move south along Africa, then east, and turn north along Australia to come under the influence of trade winds once again.

The tides of the Indian Ocean vary greatly, but not so much as those in the Atlantic or Pacific oceans. In Collier Bay, near Derby, Australia, the high and low tides may differ by as much as 36 feet (11 meters). The difference may be little more than an inch near Geraldton and near Bunbury, Australia.

Industry. The natural resources found in the Indian Ocean are used by industrialized countries worldwide. Petroleum is produced by drilling into the ocean floor near India. Huge oil reserves also lie under the Persian Gulf. The transportation of petroleum accounts for a high percentage of ship traffic in the Indian Ocean. Tin, titanium, and phosphorite deposits lie beneath various coastal waters.

Major Indian Ocean ports include Kolkata and Mumbai in India, Dar es Salaam in Tanzania, Durban in South Africa, and Perth in Australia. The Suez Canal connects the Red Sea to the Mediterranean Sea, providing a shipping link from the Indian Ocean to the ports of southern Europe and North Africa.

The Indian Ocean provides about 7 $\frac{3}{4}$ million tons (7 million metric tons) of fish per year, about 7 percent of the world's fish catch. The ocean's tropical climate hinders commercial fishing because fish spoil in the heat unless quickly processed or refrigerated.

Exploration. The Indian Ocean has been an important trade and travel route throughout history. Its early navigators were the ancient Arabs, Chinese, and Indians. The Greek historian Herodotus wrote about expeditions to the ocean around 600 B.C. In A.D. 1498, the Portuguese explorer Vasco da Gama sailed across the ocean. After the Suez Canal opened in 1869, the Indian Ocean became the most direct route between Europe and the Far East.

Scientists have not studied the Indian Ocean as much as other oceans. But several countries helped organize the Ocean Drilling Program. This program began a study in 1987 to learn more about the geography of the Indian Ocean floor. Harold V. Thurman

See also **Arabian Sea; Bay of Bengal; Persian Gulf; Red Sea.**

Indian paintbrush is any of about 200 species of handsome wildflowers that grow primarily in the western United States. The plant is also called *painted cup.* The flowers of the Indian paintbrush are small and mostly green. The flowers are surrounded by brightly colored leaves, called *bracts,* that look like petals. The bracts are red, yellow, pink, or lavender. One species of Indian paintbrush is the state flower of Wyoming.

J. Massey

Scientific classification. The Indian paintbrush is a member of the figwort family, Scrophulariaceae. It is genus *Castilleja.* The state flower of Wyoming is *C. linariaefolia.*

See also **Flower** (picture: Flowers of woodlands).

Indian pipe is a plant that is often mistaken for fungus. It looks like a group of clay pipes. Indian pipe most commonly grows in moist, fertile woods in North America and eastern Asia. Most Indian pipes are white, but some are pink to red. The plant does not have green leaves because it lacks chlorophyll. It obtains its food from fungi that grow near it. The scaly stem grows 6 to 10 inches (15 to 25 centimeters) tall. Each stem has a white or pink to red bell-shaped flower.

James L. Luteyn

Scientific classification. The Indian pipe is in the heath family, Ericaceae. Its scientific name is *Monotropa uniflora.*

James P. Rowan

Indian pipe

Indian Rebellion was a major Indian revolt against British rule in India. The rebellion, sometimes called the Sepoy Rebellion or Sepoy Mutiny, began in 1857 and spread across northern and central India. Thousands of people, mainly Indians, died in the fighting. At the time of the rebellion, a British trading company called the East India Company ruled most of India. In 1858, as a result of the rebellion, the British government took permanent control of the territory from the company. The Indian Rebellion ended in 1859.

The Indian Rebellion was begun by Indian soldiers, called *sepoys,* in the army of the East India Company. The sepoys became especially alarmed when the British

introduced the new Enfield rifle, which used cartridges greased in a tallow containing beef and pork fat. The cartridges had to be bitten open before being loaded into rifles. But the religious beliefs of the sepoys forbade them to bite open the cartridges. The Hindu sepoys could not eat beef. Sepoys who were Muslims (followers of Islam) could not eat pork.

The rebellion broke out in the military base at Meerut after British officers imprisoned 85 sepoys for refusing to use the cartridges. On May 10, other angry sepoys freed the prisoners and killed many British officers. The rebellion spread rapidly. The sepoys captured several major cities, including Delhi, Kanpur, and Lucknow.

Many other Indians joined the sepoys. They included Indian princes and nobles whose lands had been seized by the East India Company. Other Indians who supported the sepoys resented British attitudes toward the Hindu and Muslim ways of life. They felt threatened by the attempts of British missionaries to convert India to Christianity, and by the pace of modernization.

By the summer of 1858, stronger and better-equipped British forces had defeated most of the rebels. The British government then tried to improve relations with India. It supported big landowners, guaranteed princes their existing territories, and promised never to interfere with the Hindu or Muslim religion. But the rebellion greatly intensified anti-British feelings in India.

Alice Moulton and Edward C. Moulton

See also **East India Company; India** (History); **Kanpur**.

Indian reservation, in the United States, is an area of land set aside and reserved for American Indians and Alaskan natives as a permanent tribal homeland. Alaskan natives include Inuit (also called Eskimos) and Aleuts, as well as Indians. The nation's approximately 285 federal and state Indian reservations cover over 58 million acres (20 million hectares) in about 30 states. About 2,400,000 Indians live in the United States. Almost half of them live on reservations. Canada has more than 2,200 areas, called *reserves,* set aside for Indians.

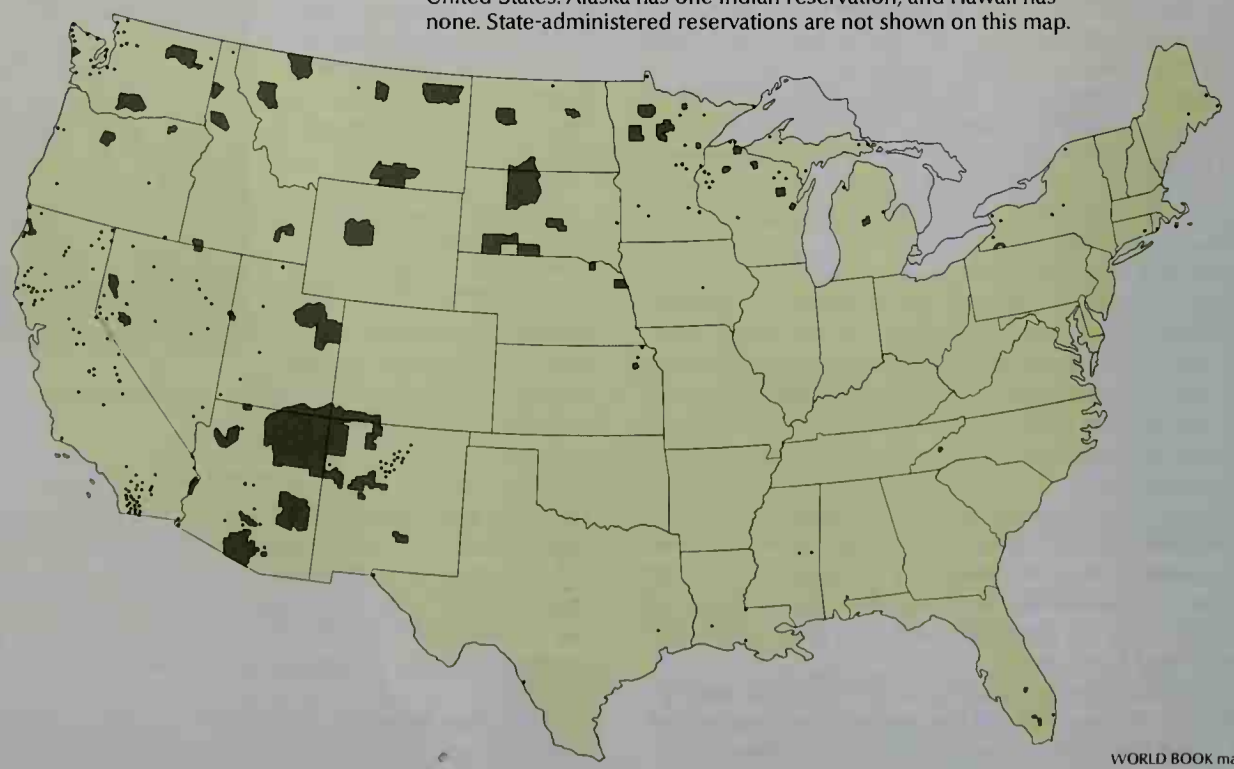
Through the years, Indian tribes have given up millions of acres of land to the United States. In exchange, the United States federal government has created Indian reservations through treaties and other laws. Reservations are owned by the Indians and are held in trust for them by the federal or state governments. Indians have the right to fish, to hunt, and to gather wild plants on their lands. Because of the trust relationship, the federal government is obligated to provide health, education, and social services to people on Indian reservations. The Bureau of Indian Affairs (BIA), an agency of the Department of the Interior, manages many of the federal programs on reservations. The Indian Health Service and certain other agencies also administer a variety of federal programs for Indians.

Description. Most Indian reservations are in rural areas. Reservations differ greatly in size and population. Some reservations cover less than 1 acre (0.4 hectare), and some have fewer than 10 Indians. The Navajo Reservation, the largest U.S. Indian reservation, is about the size of West Virginia. It covers about 14 million acres (6 million hectares) in Arizona, New Mexico, and Utah. This reservation also has a larger population than any other U.S. reservation.

Indian reservations have various kinds of tribal governments. Most tribes have a constitution. The leader of the tribal government can be a chief, chairperson, governor, or president. In most cases, this official is elected by the members of the tribe. Tribal councils are the

Indian reservations

This map shows the federally managed Indian reservations in the United States. Alaska has one Indian reservation, and Hawaii has none. State-administered reservations are not shown on this map.



WORLD BOOK map

most common form of reservation legislature. The tribal councils are elected by voters from the tribe's membership. Tribal legal systems generally consist of legislatures and tribal courts.

Agriculture is the main industry on Indian reservations. Manufacturing provides a small source of employment and income. Some tribes lease mineral rights, tax mineral production, operate businesses, and offer tourist attractions on their reservations. The operation of gambling casinos has become an important industry on Indian reservations since the 1990's.

Employment on Indian reservations is provided largely by tribal governments, federal agencies, and the various industries. But most reservations still lack well-developed economies. Indians who live on reservations have among the highest unemployment rates and lowest average incomes of any group in the United States.

Living conditions on the reservations vary from reservation to reservation depending on location, resources, and level of economic development. Most Indian lands have modern homes, but inadequate housing is a widespread problem. Reservation Indians also have the least education and the poorest health among all U.S. groups.

History. In 1638, Puritan settlers at the New Haven Colony set land aside for the Quinnipiac Indians to use for planting. In 1758, the legislature of the New Jersey Colony became the first government body to establish an Indian reservation in what is now the United States. The legislature set aside land for the Delaware Indian tribe at what is now Indian Mills, southeast of Camden. During the early and mid-1800's, most Indians in the United States were moved to reservations in the West.

The Bureau of Indian Affairs was established in 1824. Its activities included the lease or sale of forest, mineral, and other natural resources on Indian reservations to non-Indians. The bureau used the income from these activities to help provide welfare and other federal services to the Indians. The tribes had little voice in the policies of the bureau.

The bureau maintained strong control over federal reservation programs during the first half of the 1900's. During the 1960's, many tribal leaders and younger Indians began a movement to give control of these programs to the Indians themselves. President Richard M. Nixon sent a special message to Congress in 1970 calling for a new era of Indian self determination. Since then, the government has given the tribes increased authority over the natural resources on reservations, as well as housing, hospitals, schools, public works, and other facilities. Veronica E. Velarde Tiller

See also **Indian, American** (The destruction of Indian America; Native Americans today); **Indian Affairs, Bureau of.**

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Indian root. See Spikenard.

Indian runner. See Duck (picture).

Indian summer is a short period of especially fair weather and mild days. It comes in late October or early November while the leaves are turning color and falling from the trees. Indian summer has no definite dates to begin or end.

The mild, pleasant weather of Indian summer follows the autumn's first period of cold, wintry days. The days become noticeably warmer, but the nights remain chilly. The sun shines dimly and softly. The sky turns a rich blue and appears gentle and hazy near the horizon. The air remains smoky and still, with almost no wind. An Indian summer moon often has a soft yellow or orange hue. Indian summer lasts from a week to 10 days, and sometimes for two weeks. Then winter begins.

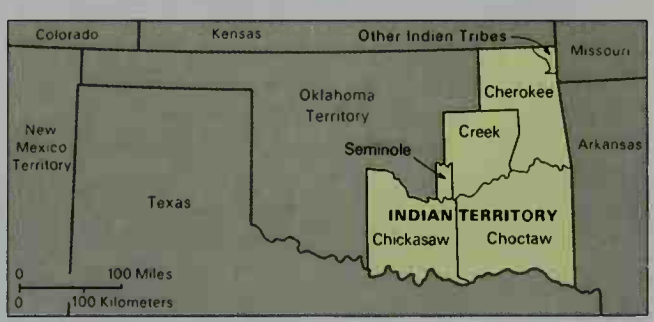
Indian summer is caused by a large mass of warm tropical air. South winds carry these warm air masses northward over the country. During Indian summer, the air mass remains *stagnant* (still). This causes the weather to remain clear and mild. The American Indians enjoyed Indian summer and looked forward to it every year. They called it the special gift of a favorite god, Cautantowwit, the god of the Southwest.

The origin of the name *Indian summer* is uncertain. One story says that the American settlers named the period after the American Indians, who told the settlers that this period would come. The settlers also believed that the smokiness of Indian summer came from fires that the Indians built on the prairies.

Other parts of the world also have a short period of fine weather similar to Indian summer. Europeans generally call it *Old Wives' Summer.* Sometimes it is referred to as *Second Summer.* The English call it *All Hallow Summer* or *St. Martin's Summer.* In Poland, the period lasts for three or four weeks, and is called *God's Gift to Poland.* Sharron G. Uhler

Indian Territory was the region west of the Mississippi River that the government set aside for the residence of Indians from about 1830 to 1906. These Indians had been moved from their homes east of the Mississippi as part of a policy to move all eastern Indians to new homes on the Great Plains, west of the 95th degree of longitude. This was done because of the pressure of white settlers who wanted to take over the lands on which the Indians had lived.

The name *Indian Territory* was applied to various regions at different times. By the mid-1850's, it included only an area almost identical with the present state of Oklahoma. It was to this region that the government moved the Five Civilized Tribes: Choctaw, Cherokee, Chickasaw, Creek, and Seminole. These tribes had previ-



WORLD BOOK map

The Indian Territory in 1906 lay east of the Oklahoma Territory. The Five Civilized Tribes occupied most of the territory, and other tribes lived in the northeast corner.

ously lived in the southeastern states. The Indian Territory had no unified political organization. The Indians were permitted to govern themselves as long as they kept the peace.

In 1866, the tribes were required to give up the western part of their territory to the United States for the use of other Indians. This was partly to punish them for helping the South during the Civil War. Reservations in this region were set aside at various times for the Osage, the Arapaho, the Cheyenne, the Wichita, the Kiowa, and the Comanche. Some of the lands in this region not assigned as Indian reservations were opened to white settlement in 1889. So many white settlers came in that the Territory of Oklahoma, in the western part of the present state of Oklahoma, was organized during the following year (see **Oklahoma** [History]).

Meanwhile, homes for other Indians whose land had been taken, such as the Ottawa, Peoria, Shawnee, Modoc, and Quapaw, had been located in the eastern half of the original Indian Territory. Most of them were in the northeast corner of the Cherokee holdings. Whites also came in an ever-increasing stream, and the tribal government of the Indians became hopelessly inadequate.

The Dawes Act of 1887 broke up tribal land holdings. In 1893, Congress created the Dawes Commission to help settle problems with the Five Civilized Tribes. Under the Curtis Act of 1898, Congress gradually dissolved tribal laws and courts, and brought the Indians under the laws and courts of the United States. Provision was made for the incorporation and government of towns. An act in 1901 made all the Indians of the Indian Territory citizens of the United States.

By 1900, the population of the Indian Territory had risen to nearly 400,000, with six times as many whites as Indians. The demand for state government was strong. A constitution for the proposed state of Sequoyah was approved by the people in 1905. But Congress had other plans. In 1906, it passed an enabling act by which Oklahoma and Indian Territory could join to become a single state. Under the terms of this act, the state of Oklahoma was admitted to the Union on Nov. 16, 1907. The Indian Territory ceased to exist. Harold W. Bradley

See also **Indian, American; Indian wars.**

Indian tobacco. See **Lobelia.**

Indian turnip. See **Jack-in-the-pulpit.**

Indian wars were the struggles between Indians and white people for the rich lands that became the United States. The bloody battles provide the background for many exciting stories and legends about frontier life and the nation's development.

English settlers established their first small colonies along the Atlantic Coast in the early 1600's. As they moved into Indian lands in greater and greater numbers, quarrels developed between the Indians and the whites. These disagreements often led to the death of an Indian or a settler. Most Indian wars resulted from such conflicts. Indian wars continued until the 1890's.

Indian wars were not like wars as we know them today. We would call them "campaigns," because the fighting generally took place within a small area, and involved comparatively few people. An Indian war usually took place between only one tribe and the white people who lived nearby. Sometimes the fighting spread, and many tribes joined in fighting the whites. Whites quickly adopted the tactics of the Indians, who struck in surprise attacks, usually at dawn. Indians killed or captured as many white men, women, and children as possible, and often scalped the dead. A French missionary wrote of Indians at war: "They approach like foxes, fight like lions, and disappear like birds."

A basic cause for the fighting between white people and Indians was the different way of life of each group. Some Indian tribes raised corn and other vegetables, but they all hunted wild animals for food and clothing.

Attack at Dawn (about 1900), an oil painting on canvas by Charles Schreyvogel; the Thomas Gilcrease Institute of American History and Art, Tulsa, Okla.

Indian wars in America began in colonial times and lasted until the 1890's. The settlement of white people on lands used by Indians led to most of the fighting between Indians and white settlers. The United States Army played a key role in the eventual defeat of the Indians.

Most white settlers made a living by farming. In the East, they cut down forests to get farmland. After they destroyed trees and underbrush, wild animals could no longer live there. In the West, white hunters killed thousands of buffaloes just for their skins. The Indians usually had to choose between moving to new hunting grounds, which were often occupied by hostile tribes, or fighting to keep their old ones. They knew that the whites threatened both their lives and their security.

Both Indians and whites were to blame for the many frontier wars. The colonists refused to recognize Indian rights. They believed that Indians were savages without souls. The Indians, in turn, did not understand the colonists' ways. For example, when Indians signed a treaty, they thought they had sold only the right to use the land, not the land itself. They did not realize that they could no longer hunt on the lands of their ancestors, just because their chiefs had made marks on a piece of paper.

The Indian wars could end in only one way. European settlers came in a steady stream and had large families. They quickly outnumbered the Indians, claimed their lands, and pushed them westward. Scholars do not know how many Indians lived in what is now the United States when white people first landed there. Many believe there were between 1 million and 5 million Indians, but some estimates run to more than 15 million. Disease, strong liquor, and almost 300 years of warfare reduced this number to about 237,000 by 1900.

But the European settlers did not bring the first warfare to the area. Indian tribes had fought among themselves for thousands of years. They struggled constantly for the best hunting grounds and village sites, for revenge after the killing of a member of their tribe, and for personal glory. An Indian brave earned his highest honors in personal combat with an enemy. Some tribes honored a warrior more for merely touching an opponent than for killing the opponent. Many Indians thought that war and hunting were the only suitable occupations for a man. But not all Indian tribes were equally warlike. Some, including the Iroquois and the Apache, fought almost all the time. Others, such as the Delaware, usually remained peaceful. After the whites came, Indians fought mainly for survival. Many peaceful tribes had to "take up the hatchet" and "go on the warpath." See **Indian, American** (Warfare).

Most Indian wars were little more than futile attempts by desperate, poorly equipped Indians to keep their land and their way of life. The white people won and often rewrote history to suit themselves. A famous Indian fighter, General Nelson A. Miles, said that "The art of war among the white people is called strategy or tactics; when practiced by the Indians it is called treachery."

Colonial days

The colonists and Indians got along well together at first. The English treated the various Indian tribes as independent powers and bought land from them by treaties. But mistrust gradually developed between the colonists and Indians, and minor incidents flared into wars. See **Colonial life in America** (Colonists and Indians).

Jamestown. English colonists settled Jamestown in 1607. The friendly chief Powhatan ruled the confederated tribes of the area. A few years after he died in 1618, Opechancanough became chief. The new leader hated the English and planned secretly to destroy their settlements. At this time, Jamestown and the other English colonies in Virginia had fewer than 4,000 settlers. In March 1622, Opechancanough led a furious assault along a 140-mile (225-kilometer) front and killed 347 colonists. The survivors retreated to Jamestown, and laid plans to massacre the Indians. They invited the Indians back to plant corn. In the fall, the whites attacked. They destroyed the fields of corn, killed many Indians, and left the rest to starve. Twelve years of warfare followed. The Indians and whites made peace in 1634, but Opechancanough attacked again in 1644. The Indians killed over 300 English people but were finally defeated after a fierce two-day battle.

The Pequot War (1637). New England colonists feared the Pequot Indians of the Connecticut River Valley more than any other Indians of the area. In 1636, Massachusetts settlers accused a Pequot of murdering a colonist. In revenge, the settlers burned a Pequot village on what is now Block Island, Rhode Island. Then Sassacus, the head Pequot chief, gathered his warriors together. Another chief, Uncas, helped the settlers with his band of Pequot (later called Mohegan). The colonists and their Indian allies attacked a Pequot village near West Mystic, Connecticut, at sunrise on June 5, 1637. They burned alive between 600 and 700 Indians. Cotton Mather, the Puritan scholar, wrote that the colonists thought this "a sweet sacrifice, and...gave the praise thereof to God." Later that month, the colonists captured most of the remaining Pequot Indians and sold them into slavery in Bermuda.

King Philip's War (1675-1676). Massasoit, the chief of the Wampanoag Indians, had been a great friend of the Plymouth colonists. But they treated his two sons, Alexander (Wamsutta) and Philip (Metacomet), unfairly. After Philip became chief in 1662, he began plotting against the colonists because he felt that his people could survive only by driving the whites out. In June 1675, he led an attack on Swansea, Massachusetts. During the next year, both sides raided villages and massacred hundreds of victims. The colonists captured Philip's wife and son and sold them into slavery. New England troops finally trapped Philip with a large force of Narragansett Indians in a swamp near South Kingston, Rhode Island. They defeated the Indians, ending the war in southern New England. Philip escaped but was hunted down and killed in 1676. Fighting in northern New England continued until 1678. The Indians killed more than 1,000 colonists and completely destroyed 12 towns.

The Pueblo revolt (1680-1692). Spaniards began moving into what is now Arizona and New Mexico as early as 1540. They conquered more than 100 Indian *pueblos,* or villages. Spanish soldiers and priests set up a forced-labor system almost like slavery and prevented the Pueblo Indians from worshiping their ancient gods. Finally the Indians struck back. Led by Popé, from San Juan pueblo, they attacked several Spanish settlements in August 1680. The Indians killed over 400 Spaniards and besieged 1,000 more in Santa Fe. After several days without water, the Spaniards escaped to El Paso del Norte (now El Paso, Texas), and Popé became the master of New Mexico.

The Pueblo Indians ruled for 12 years and destroyed almost every trace of the Roman Catholic Church. But

Chicago Historical Society

"Mad Anthony" Wayne negotiated the Treaty of Greenville in 1795, a year after his victory at the Battle of Fallen Timbers. The Indians gave up a vast tract of land in southern Ohio, and a new wave of immigrants swept into the area. A member of Wayne's staff painted this scene.

Spanish soldiers under Diego de Vargas easily reconquered the territory in 1692, after Popé's death.

The French and Indian wars (1689-1763) were actually one long struggle between France and Britain for possession of North America. Both countries tried to win help from the Indians by bribing them with liquor and guns. Most Algonquian-speaking tribes had always been friendly to the French. So the Iroquois, who were traditional enemies of the Algonquian tribes, sided with the British. See French and Indian wars.

Along the frontier

As settlers pushed westward across North America, the British and French tried many times to settle "the Indian problem." Their leaders offered several unsuccessful plans for an Indian Barrier State along the Mississippi River that would isolate the Indians from the land-hungry pioneers. A British proclamation in 1763 forbade white settlement west of the Allegheny Mountains.

After the Revolutionary War, the new government of the United States tried to protect the Indians by treaty. The government bought land as before, but set aside parts of it for the Indians. The United States government created its first Indian reservation in 1786. But nothing could stop the American pioneers in their westward march (see Westward movement in America).

Finally the government decided that the Indians could no longer remain living on their own land, surrounded by hostile settlers, but should move farther west to land that Americans did not want. Congress passed the Indian Removal Act in 1830. This law gave the president power to move the Indians to land located west of the Mississippi River.

Pontiac's War (1763). During the French and Indian War, British traders and fur trappers had moved into the Ohio River valley of the Middle West. They drove out the French, and refused to continue the French custom of giving the Indians presents every year.

In 1762, Pontiac, an Ottawa chief, began to organize the many tribes of the region to fight the newcomers. It was probably the most far-reaching alliance of Indian tribes ever attempted in North America. In 1763, Pontiac's forces seized every British post between the Straits of Mackinac and western New York except Detroit and Fort Pitt. They besieged the fort at Detroit for about five months, but finally had to withdraw to their hunting grounds in October partly because the French cut off supplies.

Lord Dunmore's War (1774). A wave of traders and settlers in the 1770's alarmed the Indians in the southern Ohio River valley. These tribes included the Delaware, the Wyandot, the Shawnee, and the Cayuga Iroquois. Their raids gave Kentucky the name of "the dark and bloody ground." Virginia claimed the area, and its governor, Lord Dunmore, sent troops to restore order. On Oct. 10, 1774, about 3,000 soldiers defeated 1,000 Indians at what is now Point Pleasant, West Virginia. The tribes then gave up their hunting lands south of the Ohio River.

Other Midwestern conflicts (1775-1832). During the Revolutionary War, the British encouraged the Indians to fight the American colonists. Henry Hamilton, British lieutenant governor at Detroit, was called "Hair Buyer," because he was said to have bought many American scalps from Indians. However, the United States won the Northwest Territory from the British during the Revolu-

tionary War. After the war, the British hoped to regain the area and again encouraged the Indians to fight the Americans. In an area of the Northwest Territory that later became Indiana, Miami Indians under Chief Little Turtle defeated troops led by Brigadier General Josiah Harmar in 1790. A year later, an inexperienced army under Major General Arthur St. Clair retreated after a surprise attack. The Indians then formed a confederacy that included the Shawnee under Black Wolf, and the Ottawa, Chippewa, and Potawatomi under Blue Jacket. Nearly 2,000 warriors gathered along the Maumee River in Ohio as Major General "Mad Anthony" Wayne marched against them in August 1794. The two forces met in a field strewn with fallen trees near what is now Toledo, Ohio. In the 40-minute Battle of Fallen Timbers, the American forces dealt the Indians a crushing blow from which they never recovered.

In the early 1800's, the Shawnee chief Tecumseh and his brother, known as the Shawnee Prophet, tried to form another alliance against the whites. Tecumseh traveled throughout the Middle West and the South, and won many Indians to his cause. While Tecumseh was in the South, the Prophet stirred up trouble in Indiana. William Henry Harrison, governor of the Indiana Territory, organized the militia and marched to the Indians' village on the Wabash and Tippecanoe rivers. The Prophet's men attacked Harrison's army before dawn on Nov. 7, 1811, at present-day Battle Ground, Ind. The two forces fought hand-to-hand in a chilly drizzle, and the Indians fled just after daylight. Harrison's victory in the Battle of Tippecanoe helped elect him to the presidency 29 years later, in 1840. He and his running mate, John Tyler, rallied American voters with the famous slogan "Tippecanoe and Tyler too."

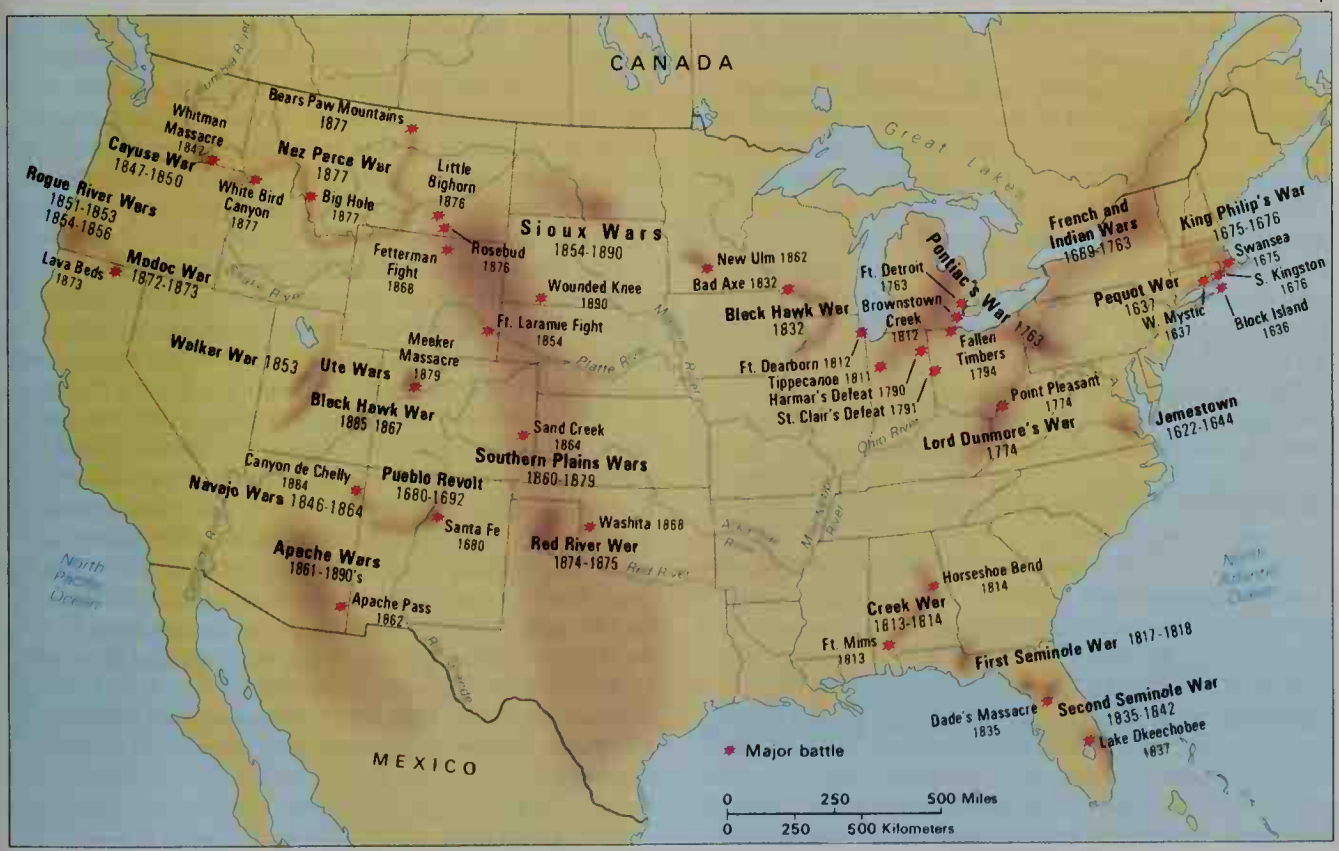
Many tribes in Tecumseh's alliance joined the British and fought against the Americans in the War of 1812. They helped the British defeat Brigadier General William Hull at Detroit, and forced many white settlers in the region to retreat eastward after the Fort Dearborn massacre of 1812 (see **Fort Dearborn**). But most Indian resistance in the Middle West crumbled after Tecumseh died in 1813, and after the British surrendered their posts the following year. The last Indian war in the area, the Black Hawk War, took place in 1832. This unsuccessful attempt by the Sauk and Fox Indians to regain one of their villages (now Rock Island, Ill.) has become well known because Abraham Lincoln took part in it, although he saw no action.

In the South (1813-1842). Tecumseh had stirred up the Creek Indians, who "took up the hatchet" throughout Alabama, Georgia, and Mississippi. In 1813 they attacked Fort Mims in Alabama, and massacred several hundred settlers. Panic seized the entire southern frontier. Andrew Jackson rallied a force of militiamen with the slogan "Remember Fort Mims." They broke the power of the Creek in 1814 at the Battle of Horseshoe Bend on the Tallapoosa River in east-central Alabama. The Creek then gave up a huge tract of land. The Seminole, a southern branch of the Creek in Florida, became angry because the Creek gave up the land. They rose against the whites in the First Seminole War (1817-1818). Jackson marched into Florida with 3,000 men. His action

Indian wars in the United States

By the mid-1800's, the government had moved the Indians from the region east of the Mississippi River. Indians in the thinly settled region west of the Mississippi fought until the 1890's. This map shows the areas where most of the fighting took place and some of the major battle sites.

WORLD BOOK map



forced Spain to give up that territory but did not completely subdue the Seminole, who began fighting again in 1835. In this Second Seminole War, they struggled desperately for seven years. Their chief, Osceola, vowed to fight "till the last drop of Seminole blood has moistened the dust of his hunting ground." The whites captured Osceola in 1837, but the Seminole fought on until they were nearly wiped out. Many surviving Seminole moved west, but some who had retreated into the Everglades remained there.

Death on the Plains

When the government first moved the Indians beyond the Mississippi River, it settled them in the Indian Country. This huge region included almost all the land between the Missouri River and the Oregon Territory. Treaties guaranteed this land to the Indians "as long as the rivers shall run and the grass shall grow." Americans at first considered the area too dry for farming. But pioneers who traveled to the Southwest, California, and Oregon soon began to cast hungry eyes on the land they passed through. Prospectors discovered gold and silver on Indian land. The government began buying parts of the land back from the Indians during the 1850's, and settled them on reservations throughout the West.

The Plains Indians fought to keep their hunting lands and to avoid being confined to reservations. These Indians, unlike those in the East, owned horses. American soldiers praised their daring enemies as "the best fighters the sun ever shone on." But fighting between Indians and whites was so bitter that many Westerners claimed that "the only good Indian is a dead Indian."

In this later period of Indian warfare, the U.S. Army took over from the state militias the job of fighting Indians. Also, the Indian Bureau, formerly in the War Department, became part of the Department of the Interior.

The Sioux wars (1854-1890) began with small clashes at Fort Laramie, Wyo., and nearby posts. In 1862, Little Crow led an uprising in Minnesota. The Indians massacred hundreds of settlers in the New Ulm area before Army troops subdued them. Many of the surviving Sioux joined other Sioux farther west. In the 1860's, Red Cloud and other strong chiefs drove out whites who entered Sioux territory. In 1868, in the Treaty of Fort Laramie, some of the Sioux agreed to live on a reservation in what is now South Dakota. But with the gold rush to the Black Hills of South Dakota in 1874, miners poured into the area, disregarding the Indians' rights. Skirmishes broke out, and the government ordered all Sioux onto the reservation. Sitting Bull and Crazy Horse refused to bring in their people. Outraged by attacks against the Sioux by the U.S. Army, Sitting Bull declared: "We are an island of Indians in a lake of whites. . . . These soldiers want war. All right, we'll give it to them!"

On June 17, 1876, a force of Sioux surprised Brigadier General George Crook's troops and defeated them in the Battle of the Rosebud in southeastern Montana. The Army then sent another force against the Indians. On June 25, troops led by Lieutenant Colonel George A. Custer encountered several thousand Sioux and Cheyenne warriors on the Little Bighorn River. Not a single soldier in Custer's immediate command of about 210 men survived "Custer's Last Stand." The Indians then split into bands in order to escape more easily. The Army caught some, and others gave themselves up. A few of the Indians, including Sitting Bull's band, fled to Canada.

A final Sioux uprising occurred in 1890, in connection with the religious cult of "the Ghost Dance" (see **Wovoka**). Major General Nelson A. Miles feared another war. He ordered the arrest of Sitting Bull, who had settled on the Standing Rock Reservation in South Dakota. When Sitting Bull resisted arrest, Indian policemen killed him. Big Foot then assumed command of the last band of hostile Sioux. The Army trapped these Indians on Wounded Knee Creek in South Dakota in December 1890, and destroyed them.

The Southern Plains (1860-1879). In Kansas, Colorado, New Mexico, and Texas, other Plains Indians also fought against being placed on reservations. Hostile tribes included the Arapaho, the Comanche, the Cheyenne under Black Kettle, and the Kiowa under Satanta. These tribes were provoked by such incidents as the Sand Creek massacre of 1864, when a large force of militia in Colorado ambushed a village of peaceful Arapaho and Cheyenne, and killed warriors, women, and children alike. Indian raids on settlements in Colorado, Kansas, New Mexico, and Texas came to a climax in the Red River War of 1874-1875. Lieutenant General Philip H. Sheridan directed a campaign against the Indians, who surrendered after over 14 battles.

The Ute tribe also rose against the whites at various times. In Utah, the Walker War of 1853 and the Black Hawk War of 1865-1867 caused many casualties among the Mormon settlers. In 1879, the Meeker Massacre marked the final Ute outbreak in Colorado. Chief Ouray restrained his people and stopped the revolt after N. C. Meeker, an unpopular Indian agent of the government, had been killed.

In California and the Northwest

Extremely bitter feeling marked Indian conflicts in California and the Northwest. During the 1850's, many California Indians died from disease and in warfare against miners and local militia. In the Northwest, the Whitman massacre in 1847 led to the Cayuse War of 1847-1850 (see **Whitman, Marcus**). Few Cayuse Indians survived this war. Whites also committed many atrocities in the Rogue River wars of the 1850's.

The Modoc War (1872-1873). The Modoc Indians of northern California and southern Oregon could barely survive on the poor reservation given them in 1864. In 1872, a group led by Captain Jack (also called Kintpuash) escaped to return to their old hunting grounds. Fighting broke out between the group and Army troops in late 1872, when the Army tried to force the Indians back to the reservation. With the Army in pursuit, the Indians fled to Tule Lake in California. There, lava beds formed by an extinct volcano furnished almost perfect fortifications. The fighting resumed in early 1873, at Tule Lake. A small band of about 60 poorly armed Indians held out for about five months, until the Army forced them to surrender. The Army hanged Captain Jack and three of his men for murder in October 1873.

The Nez Perce War (1877) began when a band of Nez Perce Indians under Chief Joseph refused to move from their home in the Wallowa Valley of Oregon. A group of warriors attacked settlers during negotiations in 1877, and Joseph reluctantly went to war. In June,

about 70 Indians held off about 100 soldiers at White Bird Canyon in Idaho. Chief Joseph then led about 800 of his people in a remarkable retreat southeast through Montana and then back north across Yellowstone Park. The Indians traveled over 1,000 miles (1,600 kilometers) and escaped from several army forces while trying to reach safety in Canada. The Indians stopped to rest near the Bears Paw Mountains in Montana, 40 miles (64 kilometers) from the Canadian border, thinking that they had shaken off their pursuers. But Nelson A. Miles, then a colonel, led his troops in a rapid march of over 200 miles (322 kilometers) to catch the Indians. Joseph and his weary band surrendered after a five-day battle.

Desert battleground

Indians in the Southwest had a different background from that of other Indians in the United States. The Spaniards, who ruled this territory for many years, believed in making them dependent on their masters. They did not settle the Indians on reservations or take them away from their hunting grounds. But they sometimes massacred whole villages if the Indians disobeyed them. Many Americans favored the same violent method. The whites would often start a fight, then call on the government to kill the "hostile" Indians.

Navajo conflicts (1846-1864). The Navajo of Arizona and New Mexico easily adopted the customs of the whites. But sometimes they raided settlements of Americans, Mexicans, and other Indians. The government sent many expeditions against the Navajo, but fighting always broke out again. Finally, in 1863, Kit Carson marched with 400 men around the Navajo stronghold, the Canyon de Chelly in northeast Arizona. His troops killed much livestock and destroyed many crops. In 1864, they entered the canyon and captured the remaining Indians. The Navajo were taken to Fort Sumner in New Mexico and imprisoned there until 1868.

Apache warfare (1861-1890's) terrorized Arizona, New Mexico, Texas, and Mexico for many years. The Apache disliked reservation life. They were determined to live as they had in the past or to die fighting. Their raids increased in the 1860's because the Civil War closed many frontier army posts. Leaders such as Cochise, Victorio, Mangas Coloradas, and Geronimo led small bands of brave, cruel warriors in hundreds of lightning attacks on lonely outposts. In 1873 and 1883, General George Crook led expeditions that returned the bands to reservations temporarily.

In 1885, one group of 11 Apache braves escaped from a reservation. In four weeks, they traveled more than 1,200 miles (1,930 kilometers), killed 38 people, and captured 250 horses and mules. Army troops pursued them, but they eventually reached safety in Mexico. The government decided on a campaign to bring about the final defeat of the Apache. Soldiers were ordered to "kill every Indian man capable of bearing arms and capture the women and children." Geronimo and his band surrendered in 1886. However, occasional raids by other bands continued. The Apache wars died away during the 1890's. Jerome A. Greene

Related articles in *World Book.* See the sections on *History* and *Places to visit* (for battlefield sites) in the state articles. For lists of articles on Indian tribes, see the tables in the Indian, American article. See also the following articles:

Indian leaders

Black Hawk
Brant, Joseph
Captain Jack
Cochise
Cornstalk
Crazy Horse
Gall
Geronimo
Hiawatha
Joseph, Chief
Little Turtle
Massasoit
Osceola
Philip, King
Pontiac
Powhatan
Red Cloud
Shawnee Prophet
Sitting Bull
Tecumseh
Uncas
Washakie
Wovoka

White leaders

Boone, Daniel
Buffalo Bill
Carson, Kit
Clark, George Rogers
Crockett, Davy
Custer, George A.
Harrison, William H.
Jackson, Andrew
Miles, Nelson A.
Reno, Marcus A.
Saint Clair, Arthur
Sheridan, Philip H.
Smith, John
Wayne, Anthony

Other related articles

Buffalo Soldiers
Colonial life in America
French and Indian wars
Indian, American
Indian Territory
Pioneer life in America
Texas Rangers
Western frontier life in America
Westward movement in America
Wounded Knee

Outline

I. Colonial days
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- B. The Pequot War
- C. King Philip's War
- D. The Pueblo revolt
- E. The French and Indian wars

II. Along the frontier
- A. Pontiac's War
- B. Lord Dunmore's War
- C. Other Midwestern conflicts
- D. In the South

III. Death on the Plains
- A. The Sioux wars
- B. The Southern Plains

IV. In California and the Northwest
- A. The Modoc War
- B. The Nez Perce War

V. Desert battleground
- A. Navajo conflicts
- B. Apache warfare

Questions

How did Indian wars on the Plains differ from those in the East?
What presidents first won fame as Indian fighters?
What part did Indians play in the War of 1812?
Why did the Indian tribes fight among themselves?
What three factors greatly reduced the number of Indians in North America?
Why did the United States change its policy toward the Indians in the early 1800's?
How were both Indians and white people to blame for the many frontier wars?
What was the basic cause of conflict between Indians and white people?

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Gene Ahrens, Shostal

Cataract Falls tumbles into the Eel River amid the lush, green forests of west-central Indiana. The state's beautiful and varied landscape makes it a popular vacation area.

Indiana *The Hoosier State*

Indiana is a small state of the United States with a large population. It covers the smallest area of any state in the Midwest. No other state west of the Appalachian Mountains is smaller, except Hawaii. Indiana ranks 38th in size among all the states but is 14th in population. It is also a major manufacturing and farming state.

Indiana is called the *Hoosier State,* and its people are known as *Hoosiers.* Historians do not know the origins of this famous nickname, but there have been several theories about it. One theory says the name is taken from a contractor named Samuel Hoosier, who liked to hire workers from Indiana. But most of the theories attribute the word to some slang expression, such as "Who's yer?" for "Who's here?"; "husher" for someone who could hush a brawl; or "hoozer," meaning "hill."

Indiana has broad, fertile plains that help make it a leading farm state. These plains form part of the rich Midwestern Corn Belt, and corn is one of Indiana's chief farm products. Hoosier farmers also produce large amounts of soybeans and hogs. But manufacturing is Indiana's single most important economic activity. The great steel mills and oil refineries of the Calumet region in northwestern Indiana are symbols of the state's industrial power. Indianapolis, the capital and largest city, is a leading manufacturing center.

Indiana's varied landscape offers many opportunities for outdoor recreation. Many people enjoy the famous sand dunes along Lake Michigan. The state's plentiful lakes and streams provide opportunities for boating, fishing, and swimming. Hunters find small game in the woods and on the plains. The colorful, rolling hills of Brown County attract many artists and nature lovers. French Lick, a well-known health and vacation resort, and Wyandotte Cave, one of the largest caverns in the United States, are in southern Indiana.

The Hoosiers chose *The Crossroads of America* as their state motto because of Indiana's central location. The state lay on the path of the westward movement of the 1800's. In 1811, General William Henry Harrison defeated several Indian tribes in the Battle of Tippecanoe. Harrison, Indiana's first territorial governor, became the ninth U.S. president in 1841. His grandson, Benjamin Harrison, a Hoosier for many years, became the 23rd president in 1889. Another Hoosier, Wendell L. Willkie, was the unsuccessful Republican presidential candidate in 1940.

Many famous writers have come from Indiana. The humorous poems of James Whitcomb Riley and stories of George Ade have delighted children and adults of several generations. The novels of Theodore Dreiser, Booth Tarkington, and Kurt Vonnegut include major works of American literature. The cartoonist Jim Davis won fame for his comic strip, "Garfield."

The contributors of this article are David L. Anderson, Professor of History at the University of Indianapolis; and Michael E. Sullivan, Associate Professor of Geography at Ball State University.

Artstreet

A huge oil refinery operates in Whiting, *above*. The northwestern corner of Indiana is a center of heavy industry. This area includes some of the nation's largest steel mills.

Interesting facts about Indiana

WORLD BOOK illustrations by Kevin Chadwick

Raggedy Ann and Andy

The Raggedy Ann doll was created in Indianapolis in 1914. Marcella Gruelle found one of her grandmother's old, battered dolls and brought it to her father, Johnny Gruelle, a cartoonist. Gruelle applied a new face and two buttons for eyes and began making up stories about the doll for his daughter. Later, a long-time friend of Gruelle's mother presented him with the original twin of the doll. The doll names of Raggedy Ann and Raggedy Andy were taken from poems by Gruelle's friend James Whitcomb Riley. Gruelle eventually wrote down the stories he had told his daughter, and they have been published as the Raggedy Ann and Raggedy Andy Books.

The first professional baseball game was played in Fort Wayne on May 4, 1871. The Fort Wayne Kekiongas defeated the Cleveland Forest Citys, 2-0.

Santa Claus, IN

The town of Santa Claus receives more than half a million packages, letters, and cards for remailing during the Christmas season. The town, named in 1852, has the only U.S. post office with the name *Santa Claus*.

The first long-distance automobile race in the United States on a track took place on May 30, 1911, at the Indianapolis Motor Speedway. Ray Harroun won the 500-mile (805-kilometer) race, averaging a speed of 74.59 miles (120.04 kilometers) per hour.

Cathlyn Melloan, Click/Chicago

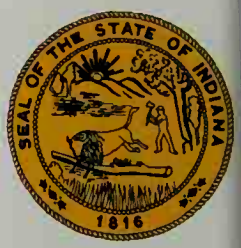
Downtown Indianapolis includes the Mile Square, *left*, a popular area that has shops, restaurants, and office buildings. Indianapolis is the capital and largest city of Indiana.

Indiana in brief

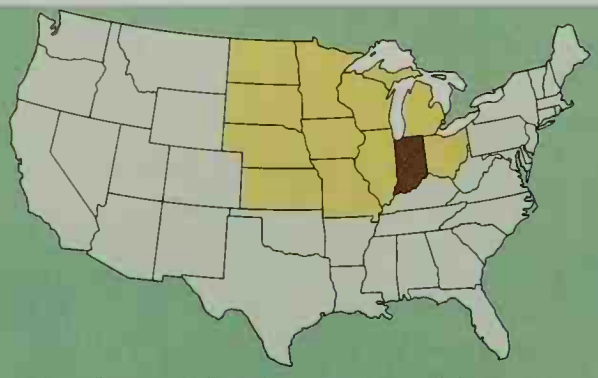
Symbols of Indiana

The state flag, adopted in 1917, has a torch that stands for liberty and enlightenment. The 19th and largest star above the torch represents Indiana, the 19th state. The state seal shows a pioneer scene. The sun setting behind the hills represents Indiana's historic position as a foothold in the westward movement. Between 1816 and 1963, there were more than 200 variations of the seal. The present seal was officially adopted in 1963.

State flag



State seal



Indiana (brown) ranks 38th in size among all the states and 12th in size among the Midwestern States (yellow).

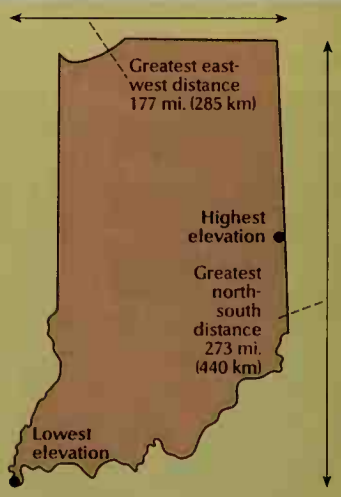
General information

Statehood: Dec. 11, 1816, the 19th state.
State abbreviations: Ind. (traditional); IN (postal).
State motto: *The Crossroads of America.*
State song: "On the Banks of the Wabash, Far Away." Words and music by Paul Dresser.

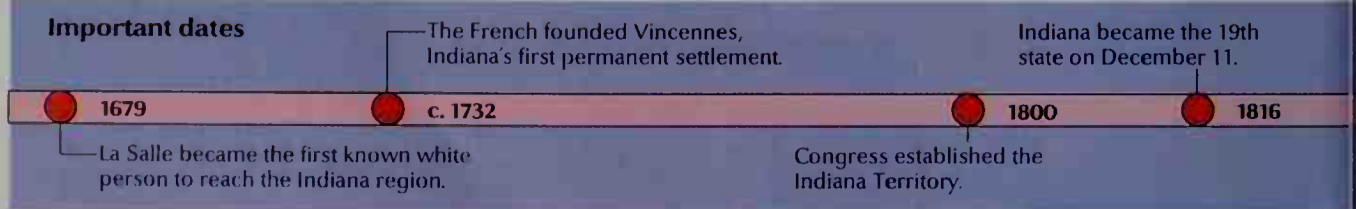
The State Capitol is in Indianapolis, the capital of Indiana since 1825. Earlier capitals were Vincennes (1800-1813) and Corydon (1813-1824).

Land and climate

Area: 36,185 sq. mi. (93,720 km²), including 315 sq. mi. (816 km²) of inland water but excluding 235 sq. mi. (608 km²) of Great Lakes water.
Elevation: *Highest*—1,257 ft. (383 m) above sea level in Wayne County. *Lowest*—320 ft. (98 m) above sea level in Posey County.
Record high temperature: 116 °F (47 °C) at Collegeville on July 14, 1936.
Record low temperature: −36 °F (−38 °C) at New Whiteland on Jan. 19, 1994.
Average July temperature: 75 °F (24 °C).
Average January temperature: 28 °F (−2 °C).
Average yearly precipitation: 40 in. (102 cm).



Important dates



State bird
Cardinal

State flower
Peony

State tree
Tulip-poplar
(yellow-poplar)

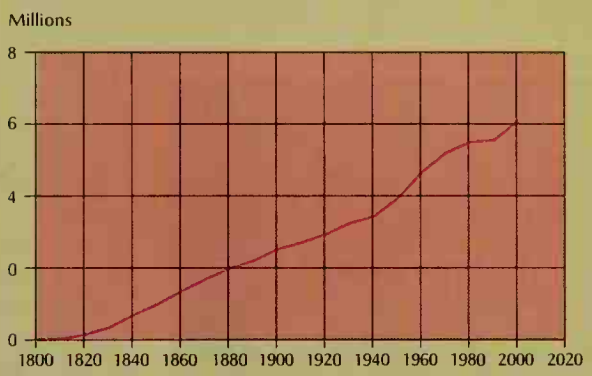
People

Population: 6,080,485 (2000 census)
Rank among the states: 14th
Density: 168 per mi² (65 per km²), U.S. average 78 per mi² (30 per km²)
Distribution*: 65 percent urban, 35 percent rural
Largest cities in Indiana

Indianapolis	791,926
Fort Wayne	205,727
Evansville	121,582
South Bend	107,789
Gary	102,746
Hammond	83,048

Source: 2000 census, except for *, where figures are for 1990.

Population trend



Source: U.S. Census Bureau.

Year	Population
2000	6,080,485
1990	5,564,228
1980	5,490,260
1970	5,195,392
1960	4,662,498
1950	3,934,224
1940	3,427,796
1930	3,238,503
1920	2,930,390
1910	2,700,876
1900	2,516,462
1890	2,192,404
1880	1,978,301
1870	1,680,637
1860	1,350,428
1850	988,416
1840	685,866
1830	343,031
1820	147,178
1810	24,520
1800	5,641

Economy

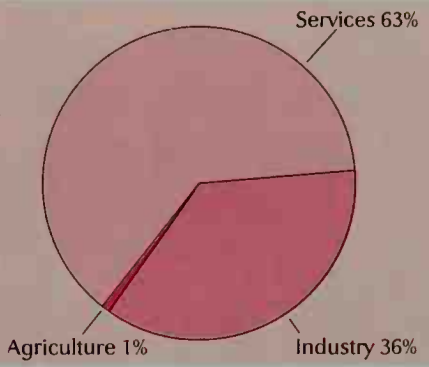
Chief products

Agriculture: corn, soybeans, hogs, poultry, beef cattle.
Manufacturing: transportation equipment, chemicals, primary metals, fabricated metal products, machinery, food products.
Mining: coal, crushed stone, sand and gravel.

Gross state product

Value of goods and services produced in 1998: $174,433,000,000. *Services* include community, business, and personal services; finance; government; trade; and transportation, communication, and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, fishing, and forestry.

Source: U.S. Bureau of Economic Analysis.



Government

State government

Governor: 4-year term
State senators: 50; 4-year terms
State representatives: 100; 2-year terms
Counties: 92

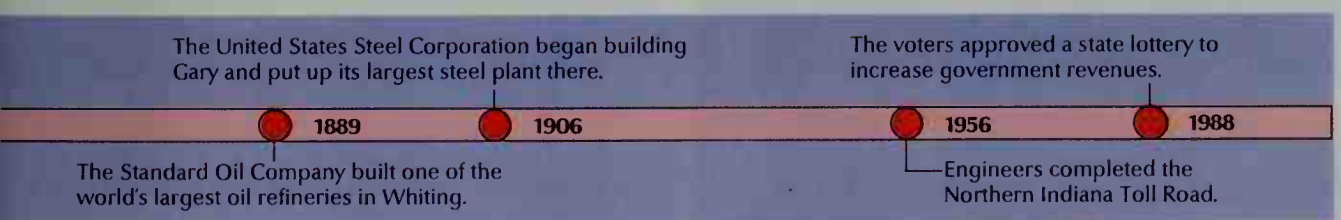
Federal government

United States senators: 2
United States representatives*: 10 (9)
Electoral votes*: 12 (11)

*Figures in parentheses are for January 2003 and beyond.

Sources of information

For information about tourism, write to: Department of Commerce, Tourism Division, One North Capitol Avenue, Suite 700, Indianapolis, IN 46204. The Web site at www.enjoyindiana.com also provides information. The Department of Commerce also handles requests for information about the state's economy.
The state's official Web site at www.state.in.us also provides a gateway to much information on Indiana's economy, government, and history.



Population. The 2000 United States census reported that Indiana had 6,080,485 people. The population had increased nearly 10 percent over the 1990 figure, 5,544,159. According to the 2000 census, Indiana ranks 14th in population among the 50 states.

About three-fourths of Indiana's people live in one of the state's metropolitan areas. About one-fourth live in the Indianapolis metropolitan area. Indiana has 13 Metropolitan Statistical Areas (see **Metropolitan area**). Ten of these areas lie entirely within the state. Two lie partly in Kentucky, and another includes parts of Ohio and Kentucky. For the names and populations of the metropolitan areas, see the *Index* to the Indiana political map.

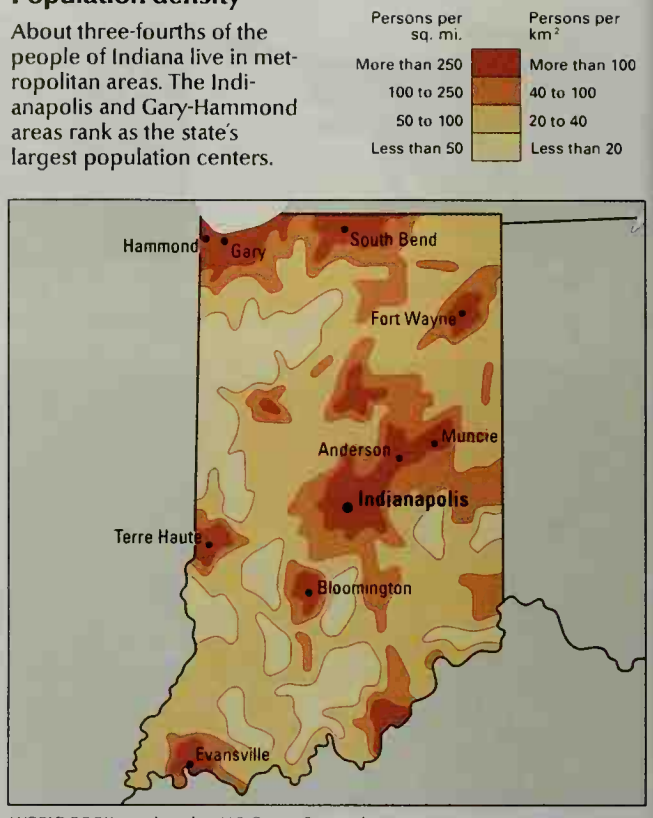
Indianapolis, the state capital, is the largest city in Indiana. Four other Indiana cities have populations of more than 100,000. They are, in order of size, Fort Wayne, Evansville, Gary, and South Bend.

Indiana's largest population groups include people of German, Irish, English, French, Dutch, and Polish descent. About 8 percent of the population are blacks.

Schools. The State Board of Education directs Indiana's school system. The board consists of 11 members, including a superintendent of public instruction. The superintendent serves as chairman of the board and chief executive officer of the state department of education. The voters elect the superintendent to a four-year term. The governor appoints the other 10 members to four-year terms. Local governing agencies, or school boards,

Population density

About three-fourths of the people of Indiana live in metropolitan areas. The Indianapolis and Gary-Hammond areas rank as the state's largest population centers.



WORLD BOOK map; based on U.S. Census Bureau data.

© Purdue University

A college basketball game between teams from Indiana University and Purdue University is a major event in Indiana. Basketball is a popular spectator sport in the state.

© Wilbur Montgomery, Eiteljorg Museum

The Eiteljorg Museum of American Indians and Western Art in Indianapolis is one of the state's many fine museums. This exhibit displays the type of tepee that the Plains Indians built.

control local school districts. Children in Indiana must attend school from age 7 through age 17, but they can leave at age 16 with the permission of an adult guardian and the school principal. For the number of students and teachers in Indiana, see **Education** (table).

In 1816, Indiana became the first state to provide in its Constitution for a statewide system of free public schools. However, the state legislature did not establish taxes to pay for these schools until 1849. In the meantime, nearly every township had a log schoolhouse built by the parents of the children. The parents took turns providing a home and salary for the schoolmaster. Some cities had private schools operated by the teachers.

In 1825, an experiment in community living began in New Harmony. The colony soon broke up, but many of its educational experiments are still used by schools today. The colony had the first classes in the country in which boys and girls were taught together. It also had one of the first nursery schools. See **New Harmony**.

In 1900, the educator William Wirt started a school system in Bluffton that combined study, play, and work. Gary adopted this school system in 1906, and it became known as the *platoon school* or *Gary School Plan*. Many U.S. cities adopted this plan or took ideas from it.

Libraries. The first public subscription library in Indiana opened in Vincennes in 1807. The Old Cathedral Library in Vincennes has one of the oldest library collections in the state, with some books dating back to the 1200's. The Indiana University library system has the largest collection of books in the state. The Lilly Library at Indiana University in Bloomington has outstanding collections of rare books and manuscripts.

Museums. The Indiana State Museum in Indianapolis has exhibits on the history of the state. Other museums in Indianapolis include the Indianapolis Museum of Art, the Eiteljorg Museum of American Indians and Western Art, and the Children's Museum, which has exhibits on history, science, and different cultures. The Lincoln Library and Museum in Fort Wayne has a collection of books, paintings, photographs, and other items pertaining to Abraham Lincoln and his family.

Purdue University

Purdue University is located in West Lafayette. Purdue Memorial Union stands on the main quadrangle of the campus.

University of Notre Dame

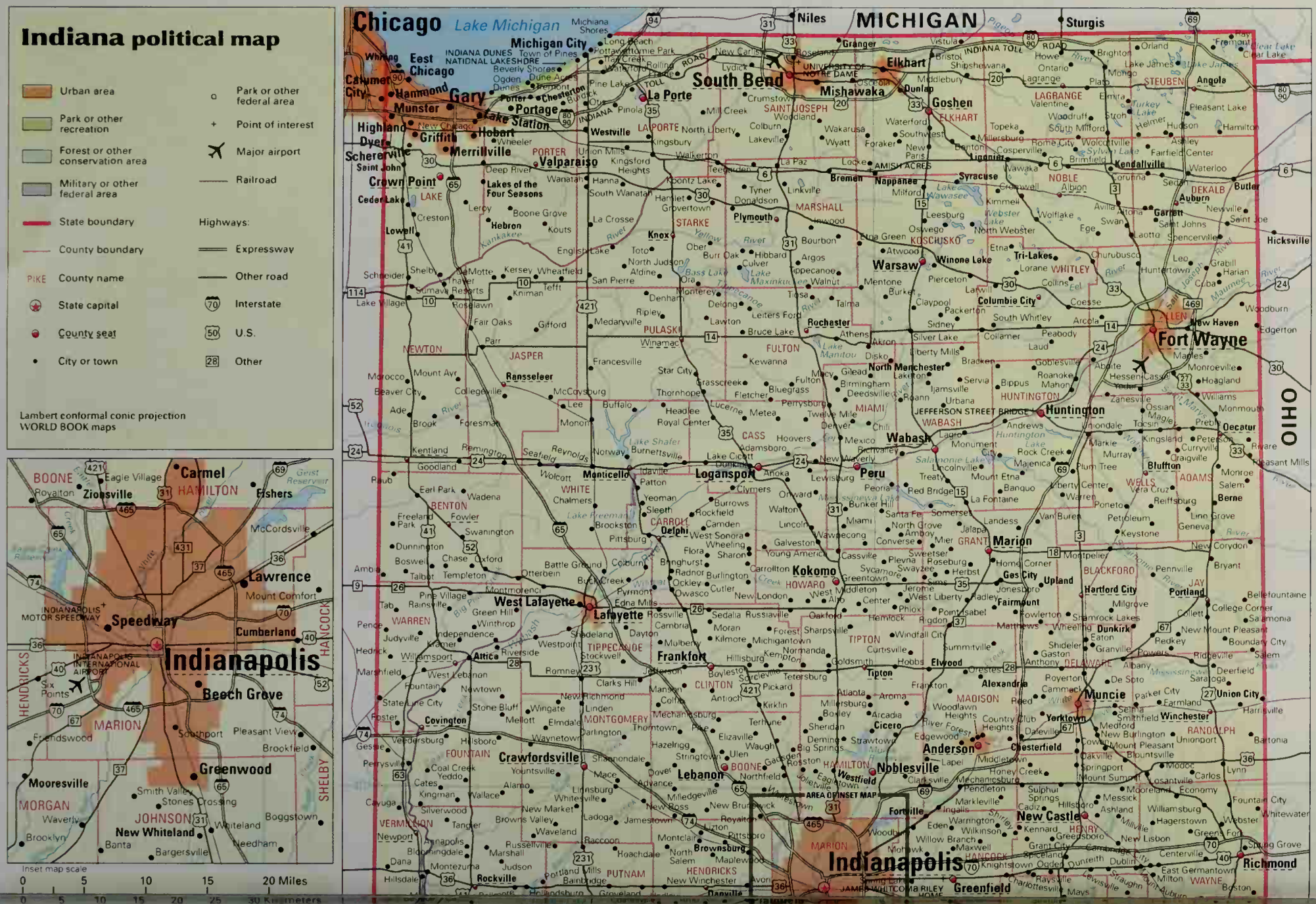
The University of Notre Dame's Memorial Library has a huge mosaic that portrays Jesus Christ as a teacher.

Universities and colleges

This table lists the universities and colleges in Indiana that grant bachelor's or advanced degrees and are accredited by the North Central Association of Colleges and Schools.

Name	Mailing address
Anderson University	Anderson
Associated Mennonite Biblical Seminary	Elkhart
Ball State University	Muncie
Bethany Theological Seminary	Richmond
Bethel College	Mishawaka
Butler University	Indianapolis
Calumet College of Saint Joseph	Whiting
Christian Theological Seminary	Indianapolis
Concordia Theological Seminary	Fort Wayne
DePauw University	Greencastle
Earlham College and Earlham School of Religion	Richmond
Evansville, University of	Evansville
Franklin College of Indiana	Franklin
Goshen College	Goshen
Grace College and Seminary	Winona Lake
Hanover College	Hanover
Huntington College	Huntington
Indiana Institute of Technology	Fort Wayne
Indiana State University	Terre Haute
Indiana University	*
Indiana Wesleyan University	Marion
Indianapolis, University of	Indianapolis
Manchester College	North Manchester
Marian College	Indianapolis
Martin University	Indianapolis
Notre Dame, University of	Notre Dame
Oakland City University	Oakland City
Purdue University	†
Rose-Hulman Institute of Technology	Terre Haute
St. Francis, University of	Fort Wayne
St. Joseph's College	Rensselaer
St. Mary-of-the-Woods College	St. Mary-of-the-Woods
St. Mary's College	Notre Dame
St. Meinrad School of Theology	St. Meinrad
Southern Indiana, University of	Evansville
Taylor University	‡
Tri-State University	Angola
Valparaiso University	Valparaiso
Wabash College	Crawfordsville

*For campuses, see Indiana University.
†For campuses, see Purdue University.
‡Campuses at Fort Wayne and Upland.


Indiana political map
Urban area
Park or other recreation
Forest or other conservation area
Military or other federal area
State boundary
County boundary
PIKE County name
State capital
County seat
City or town
Park or other federal area
Point of interest
Major airport
Railroad
Highways:
Expressway
Other road
Interstate
U.S.
Other
Lambert conformal conic projection
WORLD BOOK maps
Chicago
Lake Michigan
MICHIGAN
OHIO
Indianapolis
Fort Wayne
South Bend
Gary
Hammond
Michigan City
Elkhart
Goshen
Mishawaka
La Porte
Valparaiso
Crown Point
Merrillville
Hobart
Lake Station
Portage
Munster
Griffith
Highland
Schererville
Dyer
Lowell
Hebron
Plymouth
Warsaw
Winona Lake
Rochester
Peru
Wabash
Huntington
Marion
Kokomo
Logansport
Monticello
Delphi
Lafayette
West Lafayette
Frankfort
Crawfordsville
Greencastle
Terre Haute
Lawrence
Speedway
Cumberland
Beech Grove
Greenwood
Carmel
Fishers
Zionsville
Noblesville
Anderson
Muncie
Richmond
New Castle
Connersville
Shelbyville
Franklin
Columbus
Seymour
Bloomington
Martinsville
Mooresville
New Whiteland
Whiteland
Brownsburg
Avon
Plainfield
Danville
Rockville
Greenfield
Tipton
Kendallville
Auburn
Angola
Sturgis
Niles
Decatur
Berne
Bluffton
Portland
Hartford City
Winchester
Union City
Connersville
Inset map scale
0 5 10 15 20 Miles
0 5 10 15 20 25 30 Kilometers

ILLINOIS
KENTUCKY
Terre Haute
Bloomington
Martinsville
Franklin
Columbus
Shelbyville
Seymour
Bedford
Brownstown
Madison
Vincennes
Washington
Jasper
Paoli
Salem
Scottsburg
Sellersburg
New Albany
Jeffersonville
Louisville
Shively
Pleasure Ridge Park
Valley Station
Evansville
Henderson
Owensboro
Princeton
Mount Carmel
Carmi
Effingham
Charleston
Mattoon
Marshall
Robinson
Olney
Flora
Fairfield
Harrisburg
Mount Vernon
Oakland City
Huntingburg
Ellettsville
Spencer
Sullivan
Bicknell
Linton
Bloomfield
Switzerland
Ohio
Wabash
White
Patoka
Muscatatuck
Kentucky
Salt
Blue
Laughery
Graham Creek
Whitewater
Big Blue
Flatrock
Driftwood
Little Blue
Eel River
Fox River
Embarras
Bonpas
Skillet
Little
Deer Creek
Big Creek
Pigeon Creek
Fork
Rolling Fork
Beech Fork
Floyds
Clarks River
Lake Lemon
Monroe Lake
Greenwood
Patoka Lake
Cataract Lake
Brookville Lake
Whitewater Canal
Muscatatuck National Wildlife Refuge
Hoosier National Forest
Crane Weapons Support Center
Lincoln Boyhood National Memorial
George Rogers Clark National Historical Park
William Henry Harrison Home
New Harmony Historic District
Brown County Craft Shops
Audubon Parkway
Blue Grass Parkway
Terre Haute
Martinsville
Franklin
Columbus
Shelbyville
Seymour
Bedford
Brownstown
Madison
Vincennes
Washington
Jasper
Paoli
Salem
Scottsburg
Sellersburg
New Albany
Jeffersonville
Louisville
Shively
Pleasure Ridge Park
Valley Station
Evansville
Henderson
Owensboro
Princeton
Mount Carmel
Carmi
Effingham
Charleston
Mattoon
Marshall
Robinson
Olney
Flora
Fairfield
Harrisburg
Mount Vernon
Oakland City
Huntingburg
Ellettsville
Spencer
Sullivan
Bicknell
Linton
Bloomfield
Switzerland
Ohio
Wabash
White
Patoka
Muscatatuck
Kentucky
Salt
Blue
Laughery
Graham Creek
Whitewater
Big Blue
Flatrock
Driftwood
Little Blue
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George Rogers Clark National Historical Park
William Henry Harrison Home
New Harmony Historic District
Brown County Craft Shops
Audubon Parkway
Blue Grass Parkway
North
38° North Latitude
88° West Longitude
86
Main map scale
0 5 10 20 40 60 80 100 120 140 160 180 200 Miles
0 5 10 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 Kilometers
1 2 3 4 5 6 7 8 9 10 11 12

Indiana map index

Metropolitan areas

Bloomington 120,563
Cincinnati (O.) 1,646,395
(1,223,948 in O.;
370,715 in Ky.;
51,732 in Ind.)
Elkhart-Goshen 182,791
Evansville 296,195
(251,366 in Ind.;
44,829 in Ky.)
Fort Wayne 502,141
Gary-Hammond 631,362
Indianapolis 1,607,486
Kokomo 101,541
Lafayette 182,821
Louisville (Ky.) 1,025,598
(801,018 in Ky.;
224,580 in Ind.)
Muncie 118,769
South Bend-
Mishawaka 265,559
Terre Haute 149,192

Counties

Adams ..... 33,625 ..E 11
Allen ..... 331,849 ..C 11
Bartholomew ..... 71,435 ..J 9
Benton ..... 9,421 ..E 5
Blackford ..... 14,048 ..E 10
Boone ..... 46,107 ..G 7
Brown ..... 14,957 ..K 8
Carroll ..... 20,165 ..E 7
Cass ..... 40,930 ..D 7
Clark ..... 96,472 ..M 9
Clay ..... 26,556 ..J 5
Clinton ..... 33,866 ..F 7
Crawford ..... 10,743 ..N 7
Daviess ..... 29,820 ..L 5
Dearborn ..... 46,109 ..J 11
Decatur ..... 24,555 ..J 10
DeKalb ..... 40,285 ..B 11
Delaware ..... 118,769 ..F 10
Dubois ..... 39,674 ..N 6
Elkhart ..... 182,791 ..A 9
Fayette ..... 25,588 ..H 11
Floyd ..... 70,823 ..N 9
Fountain ..... 17,954 ..G 5
Franklin ..... 22,151 ..J 11
Fulton ..... 20,511 ..C 8
Gibson ..... 32,500 ..N 3
Grant ..... 73,403 ..E 9
Greene ..... 33,157 ..K 5
Hamilton ..... 182,740 ..G 8
Hancock ..... 55,391 ..H 9
Harrison ..... 34,325 ..N 8
Hendricks ..... 104,093 ..H 7
Henry ..... 48,508 ..H 10
Howard ..... 84,964 ..F 8
Huntington ..... 38,075 ..D 10
Jackson ..... 41,335 ..K 9
Jasper ..... 30,043 ..C 5
Jay ..... 21,806 ..E 11
Jefferson ..... 31,705 ..L 10
Jennings ..... 27,554 ..K 9
Johnson ..... 115,209 ..J 8
Knox ..... 39,256 ..L 4
Kosciusko ..... 74,057 ..B 9
Lagrange ..... 34,909 ..A 10
Lake ..... 484,564 ..B 4
La Porte ..... 110,106 ..A 6
Lawrence ..... 45,922 ..L 7
Madison ..... 133,358 ..G 9
Marion ..... 860,454 ..H 8
Marshall ..... 45,128 ..B 8
Martin ..... 10,369 ..M 6
Miami ..... 36,082 ..D 8
Monroe ..... 120,563 ..J 7
Montgomery ..... 37,629 ..C 6
Morgan ..... 66,689 ..I 7
Newton ..... 14,566 ..C 4
Noble ..... 46,275 ..B 10
Ohio ..... 5,623 ..K 12
Orange ..... 19,306 ..M 7
Owen ..... 21,786 ..J 6
Parke ..... 17,241 ..H 5
Perry ..... 18,899 ..O 6
Pike ..... 12,837 ..M 5
Porter ..... 146,798 ..B 5
Posey ..... 27,061 ..O 3
Pulaski ..... 13,755 ..C 6
Putnam ..... 36,019 ..H 6
Randolph ..... 27,401 ..C 11
Ripley ..... 26,523 ..K 11
Rush ..... 18,261 ..I 10
St. Joseph ..... 265,559 ..A 8
Scott ..... 22,960 ..L 9
Shelby ..... 43,445 ..I 9
Spencer ..... 20,391 ..O 5
Starke ..... 23,556 ..B 7
Steuben ..... 33,214 ..A 11
Sullivan ..... 21,751 ..K 4
Switzerland ..... 9,065 ..L 12
Tippecanoe ..... 148,955 ..F 6
Tipton ..... 16,577 ..F 8
Union ..... 7,349 ..I 12
Vanderburgh ..... 171,922 ..N 4
Vermillion ..... 16,788 ..H 4
Vigo ..... 105,848 ..J 4
Wabash ..... 34,960 ..D 9
Warren ..... 8,419 ..F 4
Warrick ..... 52,383 ..O 5
Washington ..... 27,223 ..M 8
Wayne ..... 71,097 ..H 12
Wells ..... 27,600 ..E 11
White ..... 25,267 ..E 6
Whitley ..... 30,707 ..C 10

Cities and towns

Adams ..... J 10
Advance ..... 562 ..C 7
Akron ..... 1,076 ..C 8
Alamo ..... 137 ..G 5
Albany ..... 2,368 ..F 11
Albion° ..... 2,284 ..B 10
Alexandria ..... 6,260 ..F 9
Allordsville ..... 112 ..M 6
Alquina ..... I 11
Alton ..... 53 ..N 7
Altona ..... 198 ..B 11
Ambia ..... 197 ..E 4
Amboy ..... 360 ..E 9
Amity ..... J 8
Amo ..... 414 ..H 7
Anderson° ..... 59,734 ..C 9
Andersonville ..... I 11
Andrews ..... 1,290 ..D 10
Angola° ..... 7,344 ..A 11
Arcadia ..... 1,747 ..G 8
Arcola ..... C 10
Argos ..... 1,613 ..C 8
Arlington ..... J 10
Ashley ..... 1,010 ..A 11
Athens ..... C 8
Atlanta ..... 761 ..G 8
Attica ..... 3,491 ..F 5
Atwood ..... C 9
Auburn° ..... 12,074 ..B 11
Aurora ..... 3,965 ..K 12
Austin ..... 4,724 ..L 9
Avilla ..... 2,049 ..B 11
Avoca ..... K 7
Bainbridge ..... 743 ..H 6
Banta ..... H 2
Bargersville ..... 2,120 ..H 2
Batesville ..... 6,033 ..J 11
Battle Ground ..... 1,323 ..E 6
Beanblossom ..... J 8
Bedford° ..... 13,768 ..L 7
Beech Grove ..... 14,880 ..F 2
Belleville ..... I 7
Bellmore ..... H 5
Benton ..... B 9
Berne ..... 4,150 ..E 11
Bethany ..... 94 ..I 7
Beverly Shores ..... 708 ..A 6
Bicknell ..... 3,378 ..L 5
Bippus ..... D 10
Birdseye ..... 465 ..N 6
Blackhawk ..... J 9
Blairsville ..... O 3
Blanford ..... I 4
Blocher ..... L 9
Bloomfield° ..... 2,542 ..K 6
Bloomingdale ..... 319 ..H 5
Bloomington° ..... 69,291 ..K 7
Blountsville ..... 166 ..C 11
Bluffton° ..... 9,536 ..D 11
Boggstown ..... H 3
Boonville° ..... 6,834 ..O 5
Borden (New
Providence) ..... 818 ..M 9
Boston ..... 177 ..H 12
Boswell ..... 827 ..E 4
Bourbon ..... 1,691 ..B 8
Bowling Green ..... J 5
Boyleston ..... F 7
Bradford ..... N 8
Brazil° ..... 8,188 ..I 5
Bremen ..... 4,486 ..B 8
Bridgeton ..... I 5
Bright† ..... 5,405 ..J 12
Brighton ..... A 10
Brimfield ..... B 10
Bringhurst ..... E 7
Bristol ..... 1,382 ..A 9
Brook ..... 1,062 ..D 4
Brookfield ..... G 3
Brooklyn ..... 1,545 ..H 1
Brooksburg ..... 74 ..L 11
Brookston ..... 1,717 ..E 6
Brookville° ..... 2,652 ..J 11
Brownsburg ..... 14,520 ..H 7
Brownstown° ..... 2,978 ..L 8
Brownsville ..... I 11
Bruceville ..... 469 ..L 4
Bryant ..... 272 ..E 11
Buck Creek ..... E 6
Buckskin ..... N 4
Buena Vista ..... I 11
Buffalo ..... 672 ..D 6
Bunker Hill ..... 987 ..E 8
Burket ..... 195 ..C 9
Burlington ..... 444 ..E 7
Burdick ..... A 6
Burnettsville ..... 373 ..D 7
Burney ..... J 10
Burns City ..... I 6
Burns Harbor* ..... 766 ..A 5
Burr Oak ..... C 7
Burrows ..... E 7
Busseron ..... L 4
Butler ..... 2,725 ..B 12
Butlerville ..... K 10
Cadiz ..... 161 ..G 10
Cambria ..... F 7
Cambridge City ..... 2,121 ..H 11
Camden ..... 582 ..E 7
Cammack ..... G 10
Campbellsburg ..... 578 ..L 8
Canaan ..... L 11
Cannelburg ..... 140 ..L 5
Cannelton° ..... 1,209 ..O 6
Canton ..... M 8
Carbon ..... 334 ..I 5
Cardonia ..... I 5
Carefree* ..... N 7
Carlisle ..... 2,660 ..K 4
Carlos ..... G 11
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Cartersburg ..... H 7
Carthage ..... 928 ..H 10
Cassville ..... E 8
Castleton* ..... E 2
Cates ..... G 5
Cayuga ..... 1,109 ..G 4
Cedar Grove ..... 185 ..J 12
Cedar Lake ..... 9,279 ..B 4
Celestine ..... M 6
Cementville ..... N 9
Center ..... F 8
Center Point ..... 292 ..J 5
Centerton ..... I 7
Centerville ..... 2,427 ..H 11
Central Barren ..... N 8
Chalmers ..... 513 ..E 6
Chambersburg ..... M 7
Chandler ..... 3,094 ..O 4
Charlestown ..... 5,993 ..M 9
Charlottesville ..... H 10
Chesterfield ..... 2,969 ..G 10
Chesterton ..... 10,488 ..A 5
Chili ..... D 8
Chrisney ..... 544 ..O 5
Churubusco ..... 1,666 ..C 10
Cicero ..... 4,303 ..G 8
Clarks Hill ..... 680 ..F 6
Clarksburg ..... I 10
Clarksville ..... 21,400 ..N 9
Clay City ..... 1,019 ..J 5
Claypool ..... 311 ..C 9
Clayton ..... 693 ..H 7
Clear Creek ..... K 7
Clear Lake ..... 244 ..A 12
Clear Springs ..... K 8
Clermont* ..... 1,477 ..F 1
Clifford ..... 291 ..J 9
Clinton ..... 5,126 ..I 4
Cloverdale ..... 2,243 ..I 6
Cloverland ..... I 5
Coal City ..... J 5
Coalmont ..... J 5
Coatesville ..... 516 ..H 6
Coesse ..... C 10
Colburn ..... E 6
Colfax ..... 768 ..G 6
Collamer ..... C 9
Collegeville† ..... 865 ..D 5
Columbia City° ..... 7,077 ..C 10
Columbus° ..... 39,059 ..J 9
Commiskey ..... L 9
Connersville° ..... 15,411 ..I 11
Converse ..... 1,137 ..E 9
Cortland ..... K 9
Corunna ..... 254 ..B 11
Cory ..... J 5
Corydon° ..... 2,715 ..N 8
Cottage Grove ..... I 12
Country Club
Heights* ..... 91 ..G 9
Covington° ..... 2,565 ..G 4
Cowan ..... G 10
Craigville ..... D 11
Crandall ..... 131 ..N 8
Crane ..... 203 ..L 6
Crawfords-
ville° ..... 15,243 ..G 6
Creston ..... B 4
Cromwell ..... 452 ..B 10
Cross Plains ..... K 11
Crothersville ..... 1,570 ..L 9
Crown Point° ..... 19,806 ..B 4
Crows Nest* ..... 96 ..E 2
Crumstown ..... A 7
Culver ..... 1,539 ..C 7
Cumberland* ..... 5,500 ..F 3
Cutler ..... E 7
Cuzco ..... M 6
Cynthiana ..... 693 ..N 3
Dale ..... 1,568 ..N 5
Daleville ..... 1,658 ..G 10
Dana ..... 662 ..H 4
Danville° ..... 6,418 ..H 7
Darlington ..... 854 ..G 6
Darmstadt ..... 1,313 ..O 4
Daylight ..... O 4
Dayton ..... 1,120 ..F 6
Decatur° ..... 9,528 ..D 12
Decker ..... 283 ..M 4
Deedsville ..... D 8
Deep River ..... B 5
Delaware ..... K 11
Delong ..... C 7
Delphi° ..... 3,015 ..E 6
DeMotte ..... 3,234 ..C 5
Denham ..... C 6
Denver ..... 541 ..D 8
Depauw ..... N 8
Deputy ..... L 10
Dillsboro ..... 1,436 ..K 11
Disko ..... C 9
Dolittle Mills ..... N 7
Donaldson ..... B 7
Dover ..... J 12
Downeyville ..... J 10
Dublin ..... 697 ..H 11
Dubois ..... M 6
Dugger ..... 955 ..K 5
Dune Acres ..... 213 ..A 5
Dunkirk ..... 2,646 ..F 11
Dunlap† ..... 5,887 ..A 9
Dunreith ..... 184 ..H 10
Dupont ..... 392 ..L 10
Dyer ..... 13,895 ..B 4
Eagle Village ..... E 2
Eagletown ..... G 8
Earl Park ..... 485 ..E 4
East Chicago ..... 32,414 ..A 4
East Enterprise ..... L 11
East
Germantown ..... 243 ..H 11
Eaton ..... 1,603 ..F 10
Eckerty ..... N 7
Economy ..... 200 ..G 11
Eden ..... H 9
Edgerton ..... C 12
Edgewood ..... 1,988 ..G 9
Edinburgh ..... 4,505 ..J 9
Edwardsport ..... 363 ..L 5
Edwardsville ..... N 9
Elberfeld ..... 636 ..N 4
Elizabeth ..... 137 ..N 9
Elizabethtown ..... 391 ..K 9
Elkhart ..... 51,874 ..A 9
Ellettsville ..... 5,078 ..J 7
Elmira ..... A 11
Elnora ..... 721 ..L 5
Elwood ..... 9,737 ..F 9
Eminence ..... I 7
Emison ..... L 4
English° ..... 673 ..N 7
Etna Green ..... 663 ..B 8
Eureka ..... O 5
Ewing ..... K 8
Evansville° ..... 121,582 ..O 4
Everton ..... I 11
Fair Oaks ..... C 5
Fairbanks ..... J 4
Fairland† ..... 1,276 ..I 9
Fairmount ..... 2,992 ..F 10
Fairview Park ..... 1,496 ..I 4
Falmouth ..... H 10
Farmersburg ..... 1,180 ..J 4
Farmland ..... 1,456 ..G 11
Ferdinand ..... 2,277 ..N 6
Fillmore ..... 545 ..I 6
Finly ..... H 9
Fishers ..... 37,835 ..E 3
Flat Rock ..... J 9
Flora ..... 2,227 ..E 7
Florence ..... L 12
Floyds Knobs ..... N 9
Folsomville ..... N 5
Fontanet ..... I 5
Foraker ..... B 9
Forest ..... F 7
Fort Branch ..... 2,320 ..N 4
Fort Ritner ..... L 8
Fort Wayne° ..... 205,727 ..C 11
Fortville ..... 3,444 ..H 9
Fountain ..... F 5
Fountain City ..... 735 ..G 12
Fountaintown ..... H 9
Fowler° ..... 2,415 ..E 5
Fowlerton ..... 298 ..F 10
Francesville ..... 905 ..D 6
Francisco ..... 543 ..N 4
Frankfort° ..... 16,662 ..F 7
Franklin° ..... 19,463 ..I 8
Frankton ..... 1,905 ..F 9
Fredericksburg ..... 92 ..M 8
Freedom ..... J 6
Freelandville ..... L 5
Freetown ..... K 8
Fremont ..... 1,696 ..A 11
French Lick ..... 1,941 ..M 7
Friendship ..... K 11
Friendswood ..... G 1
Fulda ..... N 6
Fulton ..... 326 ..D 8
Galena† ..... 1,831 ..N 9
Galveston ..... 1,532 ..E 8
Garrett ..... 5,803 ..B 11
Gary ..... 102,746 ..A 5
Gas City ..... 5,940 ..E 10
Gaston ..... 1,010 ..F 10
Geneva ..... 1,368 ..E 11
Gentryville ..... 262 ..O 5
Georgetown*† ..... 4,497 ..A 8
Georgetown ..... 2,227 ..N 9
Gifford ..... C 5
Glenwood ..... 318 ..I 11
Glezon ..... M 5
Goldsmith ..... F 8
Goodland ..... 1,096 ..D 5
Goshen° ..... 29,383 ..A 9
Gosport ..... 715 ..J 6
Grabill ..... 1,113 ..C 11
Grammer ..... K 9
Grandview ..... 696 ..O 5
Granger† ..... 28,284 ..A 8
Graysville ..... K 4
Greencastle° ..... 9,880 ..I 6
Greendale ..... 4,296 ..K 12
Greenfield° ..... 14,600 ..H 9
Greensboro ..... 174 ..H 10
Greensburg° ..... 10,260 ..J 10
Greens Fork ..... 371 ..H 11
Greentown ..... 2,546 ..E 8
Greenville ..... 591 ..N 9
Greenwood ..... 36,037 ..G 2
Griffin ..... 160 ..N 3
Griffith ..... 17,334 ..A 4
Grovertown ..... B 7
Guilford ..... J 12
Gulivoire
Park*† ..... 2,974 ..A 8
Gwynneville ..... I 9
Hadley ..... H 7
Hagerstown ..... 1,768 ..H 11
Hall ..... I 7
Hamburg ..... M 9
Hamilton ..... 1,233 ..A 12
Hamlet ..... 820 ..B 7
Hammond ..... 83,048 ..A 4
Hanna ..... B 6
Hanover ..... 2,834 ..L 10
Hardinsburg ..... 244 ..M 8
Harlan ..... C 12
Harmony ..... 589 ..I 5
Harrodsburg ..... K 7
Hartford City° ..... 6,928 ..F 10
Hartsville ..... 376 ..J 9
Hatfield ..... O 5
Haubstadt ..... 1,529 ..N 4
Hayden ..... K 9
Haysville ..... M 6
Hazelwood ..... I 7
Hazleton ..... 288 ..M 4
Hebron ..... 3,596 ..B 5
Helmer ..... A 11
Helmsburg ..... J 8
Heltonville ..... K 7
Hemlock ..... F 8
Henryville ..... 1,545 ..M 9
Hidden
Valley*† ..... 4,417 ..J 12
Highland ..... 23,546 ..A 4
Highland*† ..... 4,107 ..O 4
Hillisburg ..... F 7
Hillsboro ..... 489 ..G 5
Hillsboro ..... G 10
Hillsdale ..... O 4
Hillsdale ..... H 4
Hoagland ..... D 11
Hobart ..... 25,363 ..A 5
Hobbs ..... F 9
Holland ..... 695 ..N 5
Hollandsburg ..... H 5
Holton ..... 407 ..K 10
Home Corner ..... E 10
Homecroft* ..... 751 ..E 2
Homer ..... I 10
Honey Creek ..... G 10
Hope ..... 2,140 ..J 9
Howe ..... A 10
Hudson ..... 596 ..A 11
Huntertown ..... 1,771 ..C 11
Huntingburg ..... 5,598 ..N 6
Huntington° ..... 17,450 ..D 10
Huron ..... L 6
Hymera ..... 833 ..J 5
Idaville ..... D 7
Independence ..... F 5
Indian Heights*† ..... 3,274 ..E 8
Indian Village* ..... 144 ..A 8
Indianapolis° ..... 791,926 ..H 8
Ingalls ..... 1,168 ..G 9
Inglefield ..... O 4
Inwood ..... B 8
Ireland ..... M 5
Jamestown ..... 886 ..H 7
Jasonville ..... 2,490 ..K 5
Jasper° ..... 12,100 ..M 6
Jeffersonville° ..... 27,362 ..N 9
Jolietville ..... G 8
Jonesboro ..... 1,887 ..F 10
Jonesville ..... 220 ..K 9
Judson ..... H 5
Kasson ..... O 4
Kempton ..... 380 ..F 8
Kendallville ..... 9,616 ..B 11
Kennard ..... 455 ..H 10
Kent ..... L 10
Kentland° ..... 1,822 ..D 4
Kewanna ..... 614 ..C 7
Keystone ..... E 11
Kimmell ..... B 10
Kingman ..... 538 ..G 5
Kingsbury ..... 229 ..A 6
Kingsford
Heights ..... 1,453 ..B 6
Kingsland ..... D 11
Kirklin ..... 766 ..G 7
Knightstown ..... 2,148 ..H 10
Knightsville ..... 624 ..I 5
Kniman ..... C 5
Knox° ..... 3,721 ..B 7
Kokomo° ..... 46,113 ..E 8
Koontz Lake† ..... 1,554 ..B 7
Kouts ..... 1,698 ..B 5
Kramer ..... F 5
Laconia ..... 29 ..O 8
La Crosse ..... 561 ..B 6
Ladoga ..... 1,047 ..H 6
Lafayette° ..... 56,397 ..F 6
La Fontaine ..... 900 ..E 9
Lagrange° ..... 2,919 ..A 10
Lagro ..... 454 ..D 9
Lake Cicott ..... D 7
Lake
Dalecarlia*† ..... 1,285 ..B 4
Lake Hart ..... J 7
Lake Station ..... 13,948 ..A 5
Lake Village ..... 855 ..C 4
Lakes of the Four
Seasons† ..... 7,291 ..B 5

Laketon ..... D 9
Lakeville ..... 567 .. A 8
Lamar ..... O 6
Landess ..... E 10
Lanesville ..... 614 .. N 9
Laotto ..... B 11
La Paz ..... 489 .. B 8
Lapel ..... 1,855 .. G 9
La Porte° ..... 21,621 .. A 6
Larwill ..... 282 .. C 9
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Laurel ..... 579 .. I 11
Lawrence ..... 38,915 .. E 3
Lawrenceburg° .. 4,685 .. K 12
Lawrenceport ..... L 7
Leavenworth ..... 353 .. N 7
Lebanon° ..... 14,222 .. G 7
Leesburg ..... 625 .. B 9
Leiters Ford ..... C 7
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Leopold ..... O 7
Leroy ..... B 5
Lewis ..... J 5
Lewisville ..... 395 .. H 10
Lexington ..... L 10
Liberty° ..... 2,061 .. I 12
Liberty Center ..... E 10
Liberty Mills ..... C 9
Ligonier ..... 4,357 .. B 10
Limedale ..... I 6
Lincoln ..... E 8
Lincoln City ..... N 5
Lincolnville ..... D 9
Linden ..... 700 .. G 6
Linn Grove ..... E 11
Linton ..... 5,774 .. K 5
Little York ..... 185 .. L 9
Livonia ..... 112 .. M 8
Lizton ..... 372 .. H 7
Logansport° ..... 19,684 .. D 7
Long Beach ..... 1,559 .. A 6
Loogootee ..... 2,741 .. L 6
Losantville* ..... 280 .. G 11
Lovett ..... K 10
Lowell ..... 7,505 .. B 4
Lucerne ..... D 7
Lydick ..... A 7
Lyford ..... I 4
Lynn ..... 1,143 .. G 12
Lynnville ..... 781 .. N 5
Lyons ..... 748 .. K 5
Mackey ..... 142 .. N 4
Macy ..... 248 .. D 8
Madison° ..... 12,004 .. L 10
Magley ..... D 11
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Manchester ..... K 11
Manilla ..... J 10
Maples ..... C 11
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Marco ..... K 5
Marengo ..... 829 .. N 7
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Marion° ..... 31,320 .. E 9
Markle ..... 1,102 .. D 10
Markleville ..... 383 .. G 10
Marshall ..... 360 .. H 5
Marshfield ..... F 4
Martinsburg ..... M 8
Martinsville° ..... 11,698 .. J 7
Marysville ..... M 10
Matthews ..... 595 .. F 10
Mauckport ..... 83 .. O 8
Maxwell ..... H 9
Mays ..... H 10
McCordsville ..... 1,134 .. E 3
Mecca ..... 355 .. H 4
Mechanicsburg ..... G 7
Mechanicsburg ..... G 10
Medaryville ..... 565 .. C 6
Medora ..... 565 .. L 8
Mellott ..... 207 .. G 5
Melody Hill*† ..... 3,066 .. O 4
Memphis† ..... 400 .. M 9
Mentone ..... 898 .. C 8
Meridian Hills* ..... 1,713 .. F 8
Merom ..... 294 .. K 4
Merrillville ..... 30,560 .. B 5
Metamora ..... I 11
Mexico† ..... 984 .. D 8
Miami ..... E 8
Michiana Shores ..... 330 .. A 6
Michigan City ..... 32,900 .. A 6
Michigantown ..... 406 .. F 7
Middlebury ..... 2,956 .. A 9
Middletown ..... 2,488 .. G 10
Midland ..... K 5
Mier ..... E 9
Milan ..... 1,816 .. K 11
Milford ..... 121 .. B 9
Milford ..... 1,550 .. J 10
Mill Creek ..... A 7
Millersburg ..... 868 .. A 9
Millhousen ..... 136 .. J 10
Milltown ..... 932 .. N 8
Milroy ..... I 10
Milton ..... 611 .. H 11
Mishawaka ..... 46,557 .. A 8
Mitchell ..... 4,567 .. L 7
Modoc ..... 225 .. G 11
Mohawk ..... H 9
Mongo ..... A 10
Monmouth ..... D 12
Monon ..... 1,733 .. D 6
Monroe ..... 734 .. D 11
Monroe City ..... 548 .. M 4
Monroeville ..... 1,236 .. D 12
Monrovia ..... 628 .. I 7
Monterey ..... 231 .. C 7
Montezuma ..... 1,179 .. H 4
Montgomery ..... 368 .. L 5
Monticello° ..... 5,723 .. D 6
Montmorenci ..... F 5
Montpelier ..... 1,929 .. E 10
Mooreland ..... 393 .. G 11
Moores Hill ..... 635 .. K 11
Mooresville ..... 9,273 .. G 1
Moran ..... F 7
Morgantown ..... 964 .. J 8
Morocco ..... 1,127 .. D 4
Morris ..... J 11
Morristown ..... 1,133 .. I 9
Mount Auburn ..... 75 .. H 11
Mount Ayr ..... 147 .. D 5
Mount Carmel ..... 106 .. J 12
Mount Comfort ..... F 3
Mount Etna ..... 110 .. D 10
Mount Pleasant ..... G 10
Mount Summit ..... 313 .. G 10
Mount Vernon° ..... 7,478 .. O 3
Mulberry ..... 1,387 .. F 7
Muncie° ..... 67,430 .. G 10
Munster ..... 21,511 .. A 4
Murray ..... D 11
Nabb ..... M 10
Napoleon ..... 238 .. J 10
Nappanee ..... 6,710 .. B 8
Nashville° ..... 825 .. J 8
Nebraska ..... K 10
Needham ..... H 3
New Albany° ..... 37,603 .. N 9
New Alsace ..... J 11
New Amsterdam ..... 1 .. O 8
New Carlisle ..... 1,505 .. A 7
New Castle° ..... 17,780 .. H 10
New Chicago ..... 2,063 .. A 5
New Corydon ..... E 12
New Goshen ..... I 4
New Harmony ..... 916 .. N 3
New Haven ..... 12,406 .. C 11
New Lebanon ..... K 4
New Lisbon ..... H 11
New London ..... F 8
New Marion ..... K 10
New Market ..... 659 .. G 6
New Middletown ..... 77 .. N 8
New Palestine ..... 1,264 .. H 9
New Paris† ..... 1,006 .. B 9
New Pekin ..... 1,334 .. M 8
New Providence, see Borden (New Providence)
New Richmond ..... 349 .. G 6
New Ross ..... 334 .. G 6
New Salem ..... I 10
New Salisbury ..... N 8
New Trenton ..... J 12
New Washington ..... 547 .. M 10
New Waverly ..... D 8
New Whiteland ..... 4,579 .. H 2
Newbern ..... J 9
Newberry ..... 206 .. K 5
Newburgh ..... 3,088 .. O 4
Newpoint ..... 290 .. J 10
Newport° ..... 578 .. H 4
Newtonville ..... O 6
Newtown ..... 162 .. F 5
Newville ..... B 12
Nineveh ..... J 8
Noblesville° ..... 28,590 .. G 8
Norman ..... K 8
North Crows Nest* ..... 42 .. E 2
North Grove ..... E 9
North Judson ..... 1,675 .. C 6
North Liberty ..... 1,402 .. A 7
North Manchester ..... 6,260 .. D 9
North Salem ..... 591 .. H 7
North Terre Haute† ..... 4,606 .. I 4
North Vernon ..... 6,515 .. K 10
North Webster ..... 1,067 .. B 9
Norway ..... 437 .. D 6
Notre Dame* ..... A 8
Oak Park*† ..... 5,379 .. N 10
Oakford ..... F 8
Oakland City ..... 2,588 .. N 4
Oaktown ..... 633 .. L 4
Oakville ..... G 10
Ober ..... B 7
Ockley ..... E 7
Odon ..... 1,376 .. L 5
Ogden ..... H 10
Ogden Dunes ..... 1,313 .. A 5
Ogilville ..... K 8
Oldenburg ..... 647 .. J 11
Ontario ..... A 10
Onward ..... 81 .. E 8
Oolitic ..... 1,152 .. L 7
Orange ..... J 11
Orestes ..... 334 .. F 9
Orland ..... 341 .. A 11
Orleans ..... 2,273 .. L 7
Osceola ..... 1,859 .. A 8
Osgood ..... 1,669 .. K 11
Ossian ..... 2,943 .. D 11
Oswego ..... C 9
Otis ..... B 6
Otisco ..... M 9
Otterbein ..... 1,312 .. E 5
Otwell ..... M 5
Owensburg ..... K 6
Owensville ..... 1,322 .. N 3
Oxford ..... 1,271 .. E 5
Packerton ..... C 9
Palmyra ..... 633 .. M 8
Paoli° ..... 3,844 .. M 7
Paragon ..... 663 .. J 7
Paris Crossing ..... L 9
Parker City ..... 1,416 .. G 11
Patoka ..... 749 .. M 4
Patricksburg ..... J 6
Patriot ..... 202 .. L 12
Paxton ..... K 4
Peabody ..... C 10
Pence ..... F 4
Pendleton ..... 3,873 .. G 9
Pennville ..... 706 .. E 11
Perrysburg ..... D 8
Perrysville ..... 502 .. G 4
Peru° ..... 12,994 .. D 8
Petersburg° ..... 2,570 .. M 5
Petroleum ..... E 11
Pierceton ..... 695 .. C 9
Pierceville ..... K 11
Pimento ..... J 4
Pine Lake ..... A 6
Pine Village ..... 255 .. F 5
Pinola ..... A 6
Pittsboro ..... 1,588 .. H 7
Pittsburg ..... E 6
Plainfield ..... 18,396 .. H 7
Plainville ..... 513 .. L 5
Plato ..... A 10
Pleasant Lake ..... A 11
Pleasant Mills ..... D 12
Pleasant View ..... G 3
Plymouth° ..... 9,840 .. B 8
Point Isabel ..... F 9
Poland ..... I 6
Poneto ..... 240 .. E 11
Portage ..... 33,496 .. A 5
Porter ..... 4,972 .. A 5
Portersville ..... M 6
Portland° ..... 6,437 .. F 11
Poseyville ..... 1,187 .. N 3
Pottawattomie Park ..... 300 .. A 6
Prairie Creek ..... J 4
Prairieton ..... J 4
Preble ..... D 11
Princes Lakes ..... 1,506 .. J 8
Princeton° ..... 8,175 .. N 4
Prospect ..... M 7
Putnamville ..... I 6
Pyrmont ..... F 6
Quincy ..... I 6
Radley ..... F 9
Radnor ..... E 7
Raglesville ..... L 6
Ragsdale ..... L 4
Ramsey ..... N 8
Raub ..... E 4
Ray ..... A 12
Raysville ..... H 10
Reddington ..... K 9
Redkey ..... 1,427 .. F 11
Remington ..... 1,323 .. D 5
Rensselaer° ..... 5,294 .. D 5
Reynolds ..... 547 .. D 6
Richland City ..... O 5
Richmond° ..... 39,124 .. H 12
Richvalley ..... D 9
Ridgeville ..... 843 .. F 11
Rigdon ..... F 9
Riley ..... 160 .. J 5
Rising Sun° ..... 2,470 .. K 12
Rivare ..... D 12
River Forest ..... 28 .. G 9
Roachdale ..... 975 .. H 6
Roann ..... 400 .. D 9
Roanoke ..... 1,495 .. D 10
Rochester° ..... 6,414 .. C 8
Rock Creek ..... D 10
Rockfield ..... E 7
Rockford ..... K 9
Rockport° ..... 2,160 .. O 5
Rockville° ..... 2,765 .. H 5
Rocky Ripple* ..... 712 .. E 2
Rolling Prairie ..... A 7
Rome City ..... 1,615 .. B 10
Romney ..... F 6
Rosedale ..... 750 .. I 5
Roseland ..... 1,809 .. A 8
Roselawn ..... 3,933 .. C 5
Rossville ..... 1,513 .. F 7
Royal Center ..... 832 .. D 7
Royalton ..... E 1
Royerton ..... F 10
Rushville° ..... 5,995 .. I 10
Russellville ..... 340 .. H 6
Russiaville ..... 1,092 .. F 8
St. Anthony ..... N 6
St. Bernice ..... H 4
St. Joe ..... 478 .. B 12
St. John ..... 8,382 .. B 4
St. Joseph ..... O 3
St. Leon ..... 387 .. J 12
St. Louis Crossing ..... J 9
St. Mary-of-the-Woods .. I 4
St. Meinrad ..... N 6
St. Paul ..... 1,022 .. I 10
Salamonia ..... 158 .. F 12
Salem° ..... 6,172 .. M 8
Saline City ..... J 5
Saltillo ..... 107 .. L 8
San Pierre ..... C 6
Sandborn ..... 451 .. L 5
Sandford ..... I 4
Sandusky ..... J 10
Santa Claus ..... 2,041 .. O 6
Saratoga ..... 288 .. F 12
Sardinia ..... K 10
Schererville ..... 24,851 .. B 4
Schneider ..... 317 .. C 4
Schnellville ..... N 6
Scipio ..... K 9
Scircleville ..... F 8
Scotland° ..... K 6
Scottsburg ..... 6,040 .. L 9
Sedalia ..... F 7
Seelyville ..... 1,182 .. I 5
Sellersburg ..... 6,071 .. M 9
Selma ..... 880 .. G 11
Selvin ..... N 5
Servia ..... D 9
Seymour ..... 18,101 .. K 9
Shadeland ..... 1,682 .. F 6
Shamrock Lakes ..... 168 .. F 10
Sharpsville ..... 618 .. F 8
Shelburn ..... 1,268 .. J 4
Shelby ..... C 4
Shelbyville° ..... 17,951 .. I 9
Shepardsville ..... I 4
Sheridan ..... 2,520 .. G 8
Shideler ..... F 10
Shipshewana ..... 536 .. A 10
Shirley ..... 806 .. H 10
Shoals° ..... 807 .. L 6
Sidney ..... 168 .. C 9
Silver Lake ..... 546 .. C 9
Simonton Lake*† ..... 4,053 .. A 9
Sims ..... E 9
Six Points ..... F 1
Smith Valley ..... G 2
Smithfield ..... G 11
Smithville ..... K 7
Solsberry ..... K 6
Somerset ..... E 9
Somerville ..... 312 .. N 4
South Bend° ..... 107,789 .. A 8
South Bethany ..... J 8
South Haven*† ..... 5,619 .. A 5
South Milford ..... A 10
South Washington ..... M 5
South Whitley ..... 1,782 .. C 10
Southport ..... 1,852 .. G 2
Sparta ..... K 11
Speed ..... M 9
Speedway ..... 12,881 .. F 2
Spencer° ..... 2,508 .. J 6
Spencerville ..... B 11
Spiceland ..... 807 .. H 10
Spring Grove ..... 386 .. H 12
Spring Hill* ..... 97 .. H 8
Spring Lake ..... 262 .. H 9
Springport ..... 174 .. G 10
Springville ..... K 7
Spurgeon ..... 227 .. N 5
Stanford ..... K 6
Star City ..... 377 .. D 7
State Line City ..... 141 .. G 4
Staunton ..... 550 .. I 5
Stendal ..... N 5
Stewartsville ..... N 3
Stilesville ..... 261 .. I 7
Stinesville ..... 194 .. J 7
Stockwell ..... F 6
Stone Bluff ..... G 5
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Sullivan° ..... 4,617 .. K 4
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*Does not appear on map; key shows general location.
†Census designated place—unincorporated, but recognized as a significant settled community by the U.S. Census Bureau

°County seat.
Places without population figures are unincorporated areas.
Source: 2000 census.

The varied landscape of Indiana offers a wide variety of activities. In the north, rolling sand dunes along Lake Michigan attract many visitors. Winter resorts provide skiing, tobogganing, and other sports. On the central plains, hunters shoot game birds, rabbits, and other wildlife. Southern Indiana has famous caves, in which tourists can explore the winding underground passageways. Brown County and other southern areas have beautiful forested hills, ridges, and valleys. Many painters go there in autumn to paint the leaves turning brilliant orange, red, and yellow. Throughout the state, visitors can hike or ride horseback along old Indian trails. Boating, fishing, and swimming are popular sports in Indiana's many lakes and streams.

Indiana's most famous annual event is the Indianapolis 500 automobile race. It is held during the Memorial Day weekend at the Indianapolis Motor Speedway in the town of Speedway. About 400,000 people attend this race each year. It is one of the most popular sporting events in the nation (see **Automobile racing**).

Indianapolis Motor Speedway

The Indianapolis 500 automobile race

Places to visit

Following are brief descriptions of some of Indiana's most interesting places to visit:

Amish Acres, in Nappannee, is a historical farm that dates from about 1900 and has an Amish house and barn. Pioneer skills are demonstrated, and a restaurant serves Amish food.

Auburn-Cord-Duesenberg Museum, in Auburn, features architecture and furnishings in the art deco style of design. Exhibits at the museum include antique cars, clothing, an art collection, and early radios and phonographs.

Brown County craft shops, in Nashville, have exhibits of such crafts as doll- and pottery-making, metalcraft, weaving, and woodworking. Many shops line the main street in Nashville.

Columbus is the site of more than 50 buildings that were designed by well-known architects.

Conner Prairie Pioneer Settlement, in Noblesville, has exhibits illustrating life in Indiana during the early 1800's. The settlement includes the mansion of William Conner, an Indiana pioneer, and a log cabin trading post.

Historic Fort Wayne is a reconstruction of an American army fort of 1816 in Fort Wayne. Visitors can watch uniformed personnel carry out military activities of the time inside the fort.

Holiday World, in Santa Claus, is an amusement park for children that includes rides and a zoo where the animals can be petted. Christmas is the theme at the park.

James Whitcomb Riley Home, in Greenfield, was the residence of the famous Hoosier poet. The home has been preserved as it was when Riley was born and grew up there.

Lincoln Boyhood National Memorial, near Lincoln City, features the original cabin where Abraham Lincoln lived between the ages of 7 and 21. It also has a historical farm of the 1800's period. Lincoln's mother, Nancy Hanks Lincoln, is buried there.

New Harmony has the remains of the experimental community established there in 1825. The buildings that still stand include a fort and a mill. See **New Harmony**.

Parke County has more than 30 covered bridges. The structure over Sugar Creek is 207 feet (63 meters) long. It is the longest single-span covered bridge in the country.

William Henry Harrison Home, in Vincennes, is believed to be the first brick building in Indiana. Harrison lived there while serving as Indiana's first territorial governor.

Wyandotte Cave, near Leavenworth, is one of the largest caverns in the United States. It has five levels, 35 miles (56 kilometers) of underground passages, and many large chambers.

National forest. The Hoosier National Forest, the only national forest in Indiana, lies in the south-central part of the state.

State parks. Indiana has over 20 state park and recreation areas. For information on the state parks of Indiana, write to Director, Division of State Parks, Indiana Department of Natural Resources, State Office Building, Indianapolis, IN 46204.

Wyandotte Cave

Wyandotte Cave near Leavenworth

Annual events

January-March

Winter sports events in Laporte and New Carlisle (January and February); Parke County Maple Fair in Rockville (February-March); Indiana High School Athletic Association State Basketball Tournament in Indianapolis (March).

April-June

Sugar Creek Canoe Race in Crawfordsville (April); "500" Festival in Indianapolis (May); Bluegrass Music Festival in Beanblossom (June); Glass Festival in Greentown (June); Festival of the Arts and Crafts in Lowell (June); Miss Indiana Pageant in Michigan City (June).

July-September

Freedom Festival in Evansville (July); Circus City Festival in Peru (July); Hydroplane Regatta in Madison (July); Indiana State Fair in Indianapolis (August); National Muzzle Loading Rifle Association Championship Shoot in Friendship (August); Daviess County Turkey Trot Festival (September).

October-December

Parke County Covered Bridge Festival in Rockville (October); Harvest Homecoming in New Albany (October); Traditional Christmas at Conner Prairie Pioneer Settlement (November and December); Indianapolis Christmas Lighting Ceremony (November and December).

Indiana Department of Commerce

Historic Fort Wayne

Holiday World

Holiday World in Santa Claus

© Van Bucher, Photo Researchers

Indiana State Fair in Indianapolis

Land regions. Indiana has three main land regions. They are: (1) the Great Lakes Plains, (2) the Till Plains, and (3) the Southern Hills and Lowlands.

The Great Lakes Plains of northern Indiana form part of the fertile lowland that lies along much of the Great Lakes shoreline. This area is sometimes called the *Northern Lake and Moraine Region.* It has many small lakes and *moraines* (low hills of earth and rock left by melting glaciers). Great sand dunes border Lake Michigan's shore in Lake, La Porte, and Porter counties. South of the dunes lie fertile farmlands of rich, black soil.

Through this region runs the east-west *divide* (high land separating different river systems) that crosses North America. This divide separates the Mississippi and St. Lawrence river systems. Along the divide, many streams whose waters reach the Mississippi River are only a short distance from those that flow toward the St. Lawrence River.

The Till Plains in central Indiana are part of the great Midwestern Corn Belt. The region has soil rich for growing grain and for grazing livestock. Some low hills and shallow valleys break the region's level surface. The highest point in Indiana—1,257 feet (383 meters) above sea level—is in the eastern Till Plains, in Wayne County.

The Southern Hills and Lowlands of south-central Indiana make up the only section of the state that was not covered by glaciers during the most recent ice-age glacial advances. As a result, this region is the hilliest part of the state. It has several series of *knobs* (steep hills), with stretches of lowlands in between. Some underground streams have washed out large hollows in deposits of limestone. This action has left many caverns, including Marengo and Wyandotte caves. The southwestern section of the Southern Hills and Lowlands region provides most of Indiana's coal and petroleum. Indiana's lowest point—320 feet (98 meters) above sea level—is in Posey County, where the Wabash River flows into the Ohio River.

Rivers, lakes, and waterfalls. The Wabash River and its major branches, the White and Tippecanoe rivers, drain about two-thirds of the state. Other important rivers flowing into the Wabash include the Eel, Mississinewa, and Salamonie. The St. Joseph River joins the St. Marys at Fort Wayne to form the Maumee River, which flows into Lake Erie. The Kankakee and the Whitewater are other major rivers in Indiana. The state's southern boundary runs along the north bank of the Ohio River, but no part of the river flows through the state.

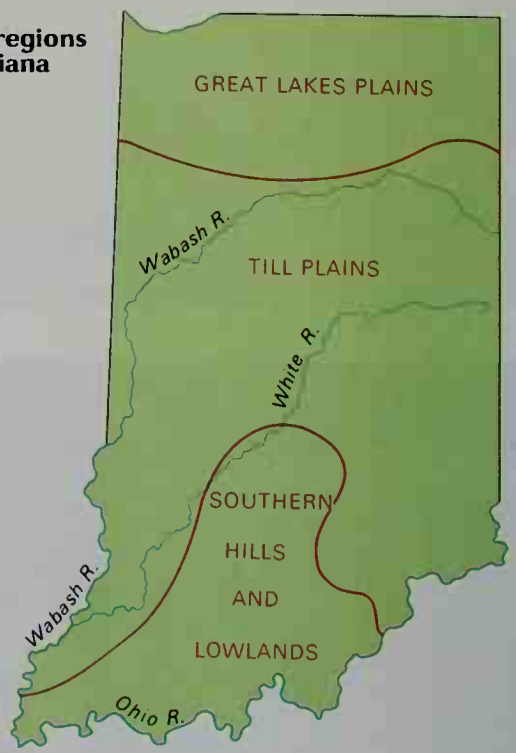
Lake Wawasee, the largest of Indiana's natural lakes, covers 4.6 square miles (12 square kilometers) in the northeastern part of the state. Other large lakes in that area include the Manitou, Maxinkuckee, and Turkey. Monroe Lake is Indiana's largest artificial lake. It covers about 17 square miles (44 square kilometers). Many small lakes are recreation areas. Clifty Falls, the state's highest waterfall, plunges 100 feet (30 meters) in Clifty Falls State Park in southern Indiana.

Plant and animal life. Forests cover about one-sixth of Indiana. The most valuable timber includes black walnut, hickory, and many varieties of maple and oak. Ash,

Artstreet

Indiana Dunes National Lakeshore attracts thousands of sunbathers each summer. The park preserves huge sand dunes that line the shores of Lake Michigan in Porter County.

Land regions of Indiana



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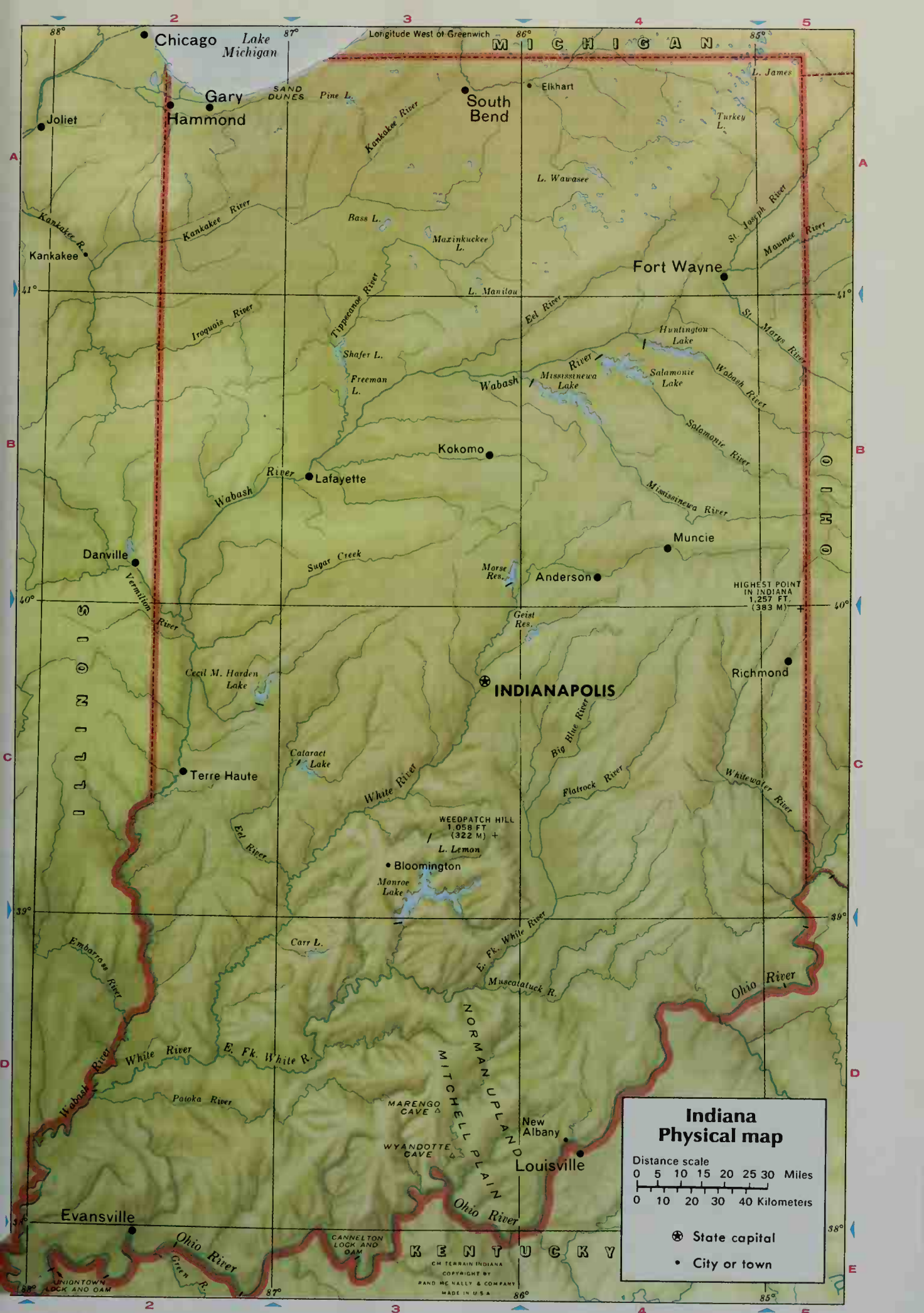

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beech, black willow, elm, sycamore, tamarack, and tuliptree (yellow-poplar) also grow in the state. The baldcypress, black tupelo, cottonwood, persimmon, and Virginia pine grow along the Ohio River.

Prickly pear cactuses grow in sands near moist, shady nooks with irises and orchids. Floating pondweeds and peppermint are seen in the northern lake region. Insect-eating plants, including the bladderwort, pitcher plant, and round-leaved sundew, also grow there.

Pussy willows, jack-in-the-pulpits, and violets appear early in spring. The spicy scent of the peony, Indiana's state flower, fills the springtime air. Sweet clover, ox-eye daisies, corn cockle, and Queen Anne's lace bloom during the summer. Autumn brings asters, fringed gentians, goldenrod, and sunflowers.

Deer, muskrats, opossums, rabbits, raccoons, skunks, squirrels, and woodchucks are found in Indiana's forests and on the prairies. Bass, catfish, pickerel, pike, salmon, and sunfish swim in the lakes and streams.

Yellow-winged sparrows and prairie larks may be seen in the prairies near swamps. The shy wood thrush lives in thick woods. Other birds include blue jays, orioles, swallows, and wrens. The cardinal is the state bird. The quail is Indiana's most common game bird. Other game birds include pheasants and wild turkeys.

Climate. Indiana has a humid climate, with cool winters and warm summers. The average January temperature ranges from 27 °F (−3 °C) in northern Indiana to 34 °F (1 °C) in the south. In July, the temperature averages 75 °F (24 °C) in the north, and 77 °F (25 °C) in the south. The state's lowest recorded temperature, −36 °F (−38 °C) occurred at New Whiteland on Jan. 19, 1994. The highest temperature, 116 °F (47 °C), was recorded at Collegeville on July 14, 1936.

Geographical differences within Indiana affect the climate in small areas of the state. The relatively warm waters of Lake Michigan warm the nearby land in the winter and cool it in the summer. Thus, winter temperatures near the lake may be slightly warmer, and summer temperatures a little cooler, than those farther inland. The many hills, valleys, and forests of southern Indiana cause temperatures in that part of the state to vary slightly within short distances.

Rainfall averages 36 inches (91 centimeters) a year in northern Indiana, and 43 inches (109 centimeters) in the south. Dry periods and floods occur occasionally in the southern section, especially in the Ohio River Valley. Snowfall ranges from more than 40 inches (100 centimeters) a year in the northern section to about 10 inches (25 centimeters) in the south. Much of the snow in northwestern Indiana is caused by moist air crossing Lake Michigan and turning into snow over land.

Average monthly weather

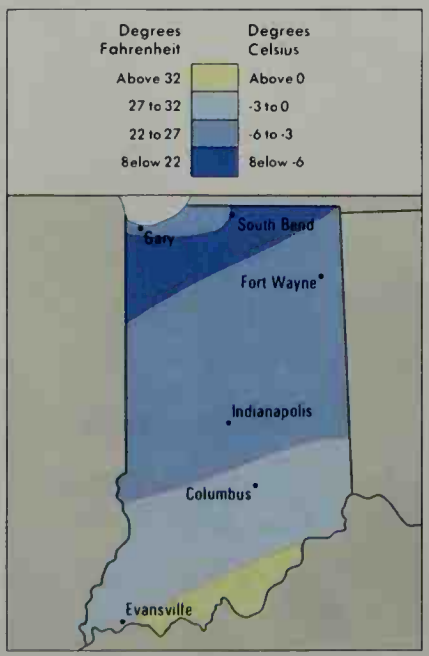
Indianapolis

	Temperatures F° High	Low	Temperatures C° High	Low	Days of rain or snow
Jan.	37	21	3	−6	12
Feb.	40	23	4	−5	11
Mar.	50	30	10	−1	12
Apr.	62	40	17	4	13
May	73	50	23	10	13
June	83	60	28	16	11
July	88	64	31	18	9
Aug.	86	63	30	17	8
Sept.	79	56	26	13	7
Oct.	67	44	19	7	7
Nov.	51	33	11	1	10
Dec.	39	23	4	−5	11

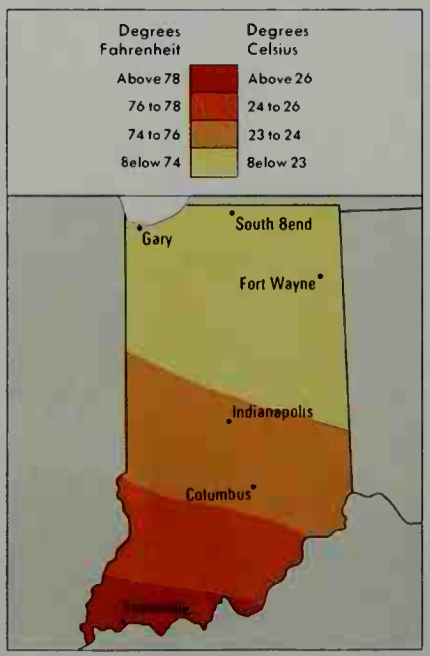
Evansville

	Temperatures F° High	Low	Temperatures C° High	Low	Days of rain or snow
Jan.	43	26	6	−3	11
Feb.	47	29	8	−2	9
Mar.	57	36	14	2	12
Apr.	68	46	20	8	12
May	77	55	25	13	12
June	85	64	29	18	10
July	89	67	32	19	9
Aug.	87	66	31	19	7
Sept.	82	59	28	15	7
Oct.	71	48	22	9	7
Nov.	56	36	13	2	9
Dec.	46	28	8	−2	10

Average January temperatures
Indiana has cold winters, with temperatures increasing toward the south. Lake Michigan warms the northwest.



Average July temperatures
Summers in Indiana are warm and humid. The weather becomes warmer toward the southern part of the state.



Average yearly precipitation
Indiana receives moderate rainfall. The south receives a little more rain, and the north has more snow.

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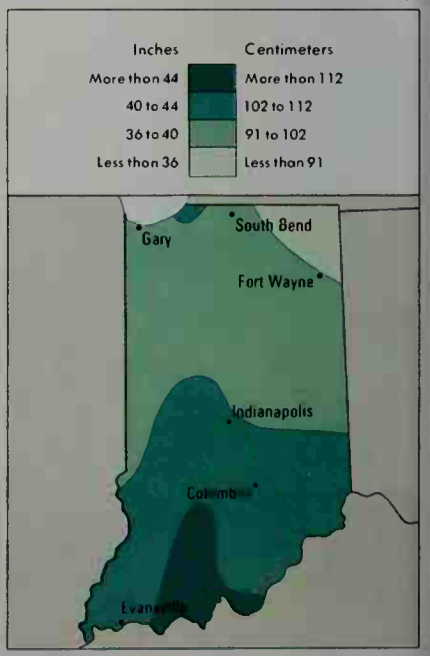


Indiana's economy depends more on manufacturing than any other state. Manufacturing accounts for nearly a third of Indiana's *gross state product*—the total value of all goods and services produced in a state in a year. But service industries, as a group, form the state's leading economic activity. Although mining and agriculture contribute smaller amounts to the gross state product, they continue to play important roles in Indiana's economy. Coal is the most valuable mined product, and corn is the most valuable farm product.

Natural resources. Fertile soil is one of Indiana's greatest natural resources. Other resources of the state include mineral deposits and plentiful water.

Soil. Fertile, gray-brown soils called *alfisols* cover most of northern and central Indiana. Dark, fertile soils known as *mollisols* are found in northwestern and west-central Indiana. The soils in southern Indiana are thinner and less fertile. They are called *ultisols* and consist of heavy clays, brown silt *loams* (combinations of clay, silt, and sand), or yellowish soils of silt and sand.

Minerals. Indiana's most valuable mined product, *bituminous* (soft) coal, is mined in the southwestern counties of the state. Clay is found in many areas. Lawrence and Monroe counties, in south-central Indiana, have great limestone quarries. The limestone is used in building and road construction, and in making cement. Sand and gravel come from many parts of the state. Southwestern Indiana has most of the state's deposits of natural gas and petroleum. Gypsum occurs in La Porte, Martin, and Owen counties.

Production and workers by economic activities

Economic activities	Percent of GSP* produced	Employed workers: Number of people	Employed workers: Percent of total
Manufacturing	31	697,900	20
Community, business, & personal services	17	943,600	26
Wholesale & retail trade	15	803,300	22
Finance, insurance, & real estate	13	217,000	6
Government	10	417,900	12
Transportation, communication, & utilities	8	168,400	5
Construction	5	208,200	6
Agriculture	1	110,700	3
Mining	†	9,700	†
Total	100	3,576,700	100

*GSP = gross state product, the total value of goods and services produced in a year.
†Less than one-half of 1 percent.
Figures are for 1998.
Sources: *World Book* estimates based on data from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

Service industries account for the largest portion of the gross state product of Indiana. Most of the service industries are concentrated in the metropolitan areas.

Community, business, and personal services form Indiana's leading service industry in terms of the gross state product. This industry includes a wide variety of businesses, including private health care, hotels and motels, law firms, and repair shops. Hotels in Indianapolis receive much business as a result of the many conventions that are held in the city.

Wholesale and retail trade form Indiana's second-ranking service industry. The wholesale trade of farm products, groceries, metal products, and transportation equipment is important in Indiana. The Farm Bureau Corporation, a large wholesale distributor of farm products, is based in Indianapolis. Another large wholesale company, Hardware Wholesalers, is based in Fort Wayne. Major retail businesses in Indiana include automobile dealerships, department stores, grocery stores, and restaurants. Indianapolis is the state's leading retail center.

Finance, insurance, and real estate rank next among the service industries. Real estate is important to the state because of the large sums of money involved in the development of homes, office buildings, and other property. Indianapolis is the home of local offices for Bank One, Indiana's largest bank. Fort Wayne is the home of Lincoln National, one of the nation's biggest insurance and investment firms. Conseco, a major financial services firm, is based in Carmel.

Government services rank fourth among Indiana's service industries. This industry includes the operation of public schools and hospitals. The public school system in Indiana employs many people. State government offices are based in Indianapolis.

Transportation, communication, and utilities form the state's fifth-ranking service industry. Indiana handles more railroad freight traffic than most other states. Several large trucking firms are headquartered in the state. Several ocean freight shipping companies operate along Lake Michigan. Telephone companies are the most important part of the communication sector. Utilities provide electric, gas, and water service. More information about transportation and communication can be found later in this section.

Manufacturing accounts for a larger portion of the gross state product in Indiana than it does in any other state. Indiana's manufactured products have a *value added by manufacture* of about $72 billion. This figure represents the increase in value of raw materials after they become finished products.

Transportation equipment is Indiana's leading manu-

Jenn-Air Company

Appliances are manufactured at this factory in Indianapolis. The production of appliances and other electrical equipment is one of the leading manufacturing activities in Indiana.

Artstreet

A field of corn thrives near Goshen. Corn is one of Indiana's most valuable farm products. Indiana ranks as a leading corn producer and one of the nation's chief agricultural states.

factured product in terms of value added by manufacture. The production of motor-vehicle and aircraft parts is a major economic activity throughout the state. Motor vehicle assembly plants operate in the Fort Wayne, Lafayette, and South Bend areas. Indiana ranks among the leading states in the production of automobile parts, truck and bus bodies, truck trailers, and motor homes. Factories in Gary manufacture railroad cars.

Chemicals are Indiana's second-ranking manufactured product. Pharmaceuticals are the state's leading chemical product. Eli Lilly, a major pharmaceutical company, is headquartered in Indianapolis. Companies in Elkhart and Evansville also produce pharmaceuticals. Other important chemical products manufactured in the state are industrial and agricultural chemicals.

Primary metals rank third in terms of value added among Indiana's manufactured products. Steel is the most important kind of primary metal made in Indiana. The Calumet Region of northwestern Indiana is one of the world's major steel-producing areas. Burns Harbor, East Chicago, and Gary are the major steel-producing centers of this region. Indiana makes more steel than any other state. It is also an important aluminum-producing state. Bedford, Lafayette, and Newburgh are the leading centers of aluminum production.

Fabricated metal products rank fourth. These products include metal stampings, pipes, springs, structural metal, wire, and valves.

Other products manufactured in Indiana include computer and electronics products, electrical equipment, food products, machinery, and rubber and plastics products. Communications equipment and computer microchips are Indiana's leading electronics products. Electrical equipment made in Indiana includes large appliances, radios, televisions, and electrical automotive parts. Baked goods, dairy products, meats, and soft drinks are the state's major food products. Engines, machine tools, and refrigeration equipment are the state's leading machinery products. Plastics products are manufactured in several parts of Indiana.

Agriculture. Farmland covers about 70 percent of Indiana's land area. The state has about 66,000 farms.

Corn and soybeans are Indiana's most valuable farm products. Together, they earn about half of the state's annual farm income. Indiana ranks among the leading states in both corn and soybean production. Farmers in all counties grow these crops, especially on the central plains. Other important crops in the state include hay and wheat.

Tomatoes are Indiana's most valuable vegetable crop. Other important vegetables include cucumbers, onions, potatoes, snap beans, and sweet corn. Apples, blueberries, and watermelons are the leading fruit crops. Indiana leads the states in the production of popcorn.

Hogs are Indiana's chief livestock product. Most parts of the state have hog farms, but production is heaviest in the region east of Lafayette. Other major livestock products include milk, beef cattle, and eggs. Cattle are raised throughout the state. Indiana is a leading egg-producing state. Farmers also raise turkeys, ducks, and sheep.

Mining. Bituminous coal is Indiana's chief mined product. Coal provides about three-fourths of Indiana's mining income. Much of Indiana's coal, however, has a high sulfur content that contributes to air pollution when burned. Most of the coal comes from surface mines in the southwestern part of the state.

Among Indiana's other mined products, crushed

Economy of Indiana

This map shows the economic uses of land in Indiana and where the state's leading farm, mineral, and forest products are produced. Major manufacturing centers are shown in red.

WORLD BOOK map

stone, and sand and gravel provide the most income. The region stretching from Indianapolis to Fort Wayne has many limestone quarries. Crushed limestone is used to make roadbeds and concrete. Indiana also quarries blocks of limestone for use in building construction. Much of the state's sand and gravel are produced from pits near the major cities. Other valuable mined products include clays and gypsum.

Electric power. Almost all of the electric power generated in Indiana comes from power plants that burn coal. A small amount of the state's power comes from hydroelectric plants and plants that burn petroleum or natural gas.

Transportation. Major railroads, bus lines, and highways crisscross the state. Oceangoing ships carry goods to world ports from the Calumet region.

The first road to cross the state from east to west was the historic Cumberland Road, or National Road, of the early 1800's. It is now U.S. Highway 40, which goes through Indianapolis. Indiana has about 93,000 miles (150,000 kilometers) of roads.

About 30 railroads provide freight service in Indiana. Passenger trains serve many Indiana cities. Indianapolis International Airport is Indiana's busiest airport. Fort Wayne and South Bend also have important airports.

Indiana's largest port is Burns Harbor in Portage. Other harbors in the Calumet region are those at Buffington and Gary and the Indiana Harbor in East Chicago. Oceangoing ships connect the ports with many countries by way of the Great Lakes and the St. Lawrence River. Lake freighters bring coal, iron ore, and limestone for the region's steel mills. Smaller ports, including the state-operated Southwind and Clark maritime centers, lie along the Ohio River.

Communication. Indiana has about 290 newspapers, about 70 of which are published daily. About 210 periodicals are published in the state. Elihu Stout, the first printer in Indiana, established the weekly *Indiana Gazette* in Vincennes in 1804. The *Gazette* was the first newspaper in the state. Indiana's first daily newspapers, the *Journal* and the *Sentinel,* were published in Indianapolis in 1851. The *Journal* later became *The Indianapolis Star,* which today is the largest newspaper in Indiana. Other leading newspapers in the state include the *South Bend Tribune.*

The *South Bend Tribune* established the state's first radio station, WSBT, in 1921. Indiana's first television stations, WTTV in Bloomington and WFBM-TV (now WRTV-TV) in Indianapolis, began operating in 1949. Indiana now has about 220 radio stations and 35 television stations. Cable television systems and Internet providers serve communities statewide.

Government

Constitution of Indiana, the second in the state's history, was adopted in 1851. It replaced the Constitution of 1816, the year Indiana became a state. An amendment to the Constitution must be proposed in the state legislature. It must then be approved by a majority of each house of two separately elected state legislatures. Finally, the proposed amendment must receive the approval of a majority of the citizens voting on it in a regular or special election. Indiana's Constitution does not provide for constitutional conventions to propose amendments.

Executive. The governor of Indiana is elected to a four-year term and may serve any number of terms, but not more than two terms in a row. The governor has the power to appoint and dismiss the heads of nearly all the state commissions, departments, and institutions and to establish the salaries of these officials in cooperation with the state budget agency. The governors of most other states do not have this power.

All high state officials in Indiana are elected to four-year terms. These officials include the lieutenant governor, attorney general, secretary of state, auditor, and treasurer.

Legislature of Indiana, called the General Assembly, consists of a 50-member Senate and a 100-member House of Representatives. The state has 50 senatorial districts and 100 representative districts. Voters in each senatorial district elect one senator, and voters in each representative district elect one representative. Senators serve four-year terms. Representatives serve two-year terms.

The legislature meets every year. The regular sessions begin by the second Monday of January. Regular sessions cannot extend beyond April 29 in odd-numbered years or beyond March 14 in even-numbered years. The governor can call a special session that cannot last more than 30 days.

Courts in Indiana are headed by the state Supreme Court and the Court of Appeals. The Supreme Court consists of a chief justice and four associate justices. A nonpartisan judicial commission selects one of the Supreme Court judges to serve as the chief justice for a five-year term. The Court of Appeals has 15 judges. One judge serves on a state tax court. New judges of the Supreme Court, the Court of Appeals, and the tax court are appointed by the governor to serve two years. The voters then decide whether a judge should be approved or rejected for a new 10-year term. Circuit courts cover one or more of all the counties in the state. Most counties also have superior and special courts.

Local government units in Indiana include counties, townships, cities, towns, school corporations, and a variety of other special taxing districts. All of Indiana's 92 counties except one are governed by three-member boards of county commissioners, elected to four-year terms. On Jan. 1, 1970, Marion County and Indianapolis adopted a metropolitan government plan providing for a mayor and 29-member council, all elected to four-year terms. The chief township official is the township trustee, also elected to a four-year term. Indiana is the only state that has townships throughout its entire area. Indiana cities cannot adopt their own charters, and must operate within the powers granted by the state government. All cities have a mayor-council government. Town councils govern almost all the towns.

Revenue. Taxation provides more than half of Indiana's *general revenue* (income). About a fourth of the state's general revenue comes from federal grants and other United States government programs. Most of

the rest comes from charges for government services. A general sales tax and a personal income tax are the major sources of tax revenue in the state. Corporate income and motor fuel taxes are also important sources of tax revenue.

Politics. The Republican Party has generally controlled Indiana politics since the Civil War (1861-1865). But the Democratic Party has been gaining strength since the depression years of the 1930's. In some elections since then, the Democrats have won control of one or both houses of the state legislature. Indiana elected its first Democratic governor in 20 years in 1988. For Indiana's electoral votes and voting record in presidential elections, see **Electoral College** (table).

Most of the people of the northern and central sections of Indiana are Republicans. The industrialized cities of Gary and South Bend, in the northern part of the state, are centers of Democratic strength. Indianapolis, in central Indiana, has one of the largest metropolitan areas with a Republican majority. Most of the people of southern Indiana are Democrats, and the New Albany-Jeffersonville area is a center of Democratic strength.

The governors of Indiana

	Party	Term
Jonathan Jennings	*Dem.-Rep.	1816-1822
Ratliff Boon	*Dem.-Rep.	1822
William Hendricks	*Dem.-Rep.	1822-1825
James B. Ray	Independent	1825-1831
Noah Noble	Whig	1831-1837
David Wallace	Whig	1837-1840
Samuel Bigger	Whig	1840-1843
James Whitcomb	Democratic	1843-1848
Paris C. Dunning	Democratic	1848-1849
Joseph A. Wright	Democratic	1849-1857
Ashbel P. Willard	Democratic	1857-1860
Abram A. Hammond	Democratic	1860-1861
Henry Smith Lane	Republican	1861
Oliver P. Morton	Republican	1861-1867
Conrad Baker	Republican	1867-1873
Thomas A. Hendricks	Democratic	1873-1877
James D. Williams	Democratic	1877-1880
Isaac P. Gray	Democratic	1880-1881
Albert G. Porter	Republican	1881-1885
Isaac P. Gray	Democratic	1885-1889
Alvin P. Hovey	Republican	1889-1891
Ira Joy Chase	Republican	1891-1893
Claude Matthews	Democratic	1893-1897
James A. Mount	Republican	1897-1901
Winfield T. Durbin	Republican	1901-1905
J. Frank Hanly	Republican	1905-1909
Thomas R. Marshall	Democratic	1909-1913
Samuel M. Ralston	Democratic	1913-1917
James P. Goodrich	Republican	1917-1921
Warren T. McCray	Republican	1921-1924
Emmett Forest Branch	Republican	1924-1925
Ed Jackson	Republican	1925-1929
Harry G. Leslie	Republican	1929-1933
Paul V. McNutt	Democratic	1933-1937
M. Clifford Townsend	Democratic	1937-1941
Henry F. Schricker	Democratic	1941-1945
Ralph F. Gates	Republican	1945-1949
Henry F. Schricker	Democratic	1949-1953
George N. Craig	Republican	1953-1957
Harold W. Handley	Republican	1957-1961
Matthew E. Welsh	Democratic	1961-1965
Roger D. Branigin	Democratic	1965-1969
Edgar D. Whitcomb	Republican	1969-1973
Otis R. Bowen	Republican	1973-1981
Robert D. Orr	Republican	1981-1989
Evan Bayh	Democratic	1989-1997
Frank L. O'Bannon	Democratic	1997-

*Democratic-Republican

© David R. Frazier

The Indiana House of Representatives meets in the State Capitol in Indianapolis. Each of its 100 members serves a two-year term.

Indian days. The first people to live in what is now Indiana were probably prehistoric Indians called *mound builders*. Many of their burial mounds, earthen forts, and village sites can still be seen (see **Mound builders**). When the first white explorers arrived in 1679, they found only a few hundred Indians. Most of these Indians belonged to the Miami tribe.

Many more tribes lived in the Indiana region at various times during the 1700's and 1800's. The Delaware, Mahican, Munsee, and Shawnee had come from the East after losing their lands to white settlers. The Huron, Kickapoo, Piankashaw, Potawatomi, and Wea had arrived from the Great Lakes area to the north. The whites forced most of these tribes to sell or surrender their lands in Indiana.

The Potawatomi were the last tribe to enter and to leave the Indiana area. They built villages in the northern section about 1795. By 1836, many Potawatomi had sold their land to the government. The rest were driven out by military force in 1838. Only a few Indians remained in the region after that.

Exploration and settlement. The first known white person in the Indiana region was the French explorer Robert Cavelier, Sieur de La Salle. He came from the French colonies in Canada in 1679, seeking a water route to the Pacific Ocean. La Salle traveled through the region down the St. Joseph and Kankakee rivers. He returned late in 1680 and explored much of the northern Indiana area.

French fur traders soon pushed farther inland from Lake Michigan. They traded beads, blankets, knives, paint, and whiskey to the Indians for animal furs. During the 1720's, the French built fur-trading posts in Miami (near present-day Fort Wayne) and in Ouiatenon (near what is now Lafayette). About 1732, the French founded Indiana's first permanent settlement, Vincennes, and built a fort there.

From the beginning of the fur trade with the Indians, the French competed with British traders. For many years, the French gained favor with the tribes because they treated the Indians as equals. But the British slowly won over the Indians because they paid higher prices for furs and also traded firearms to the Indians.

The struggle for the fur trade was a major reason for a series of wars between the French and the British in North America. The British, who claimed all the territory that stretched westward from their Atlantic colonies, defeated the French. In 1763, France gave Britain its claims to Indiana and other regions. See **French and Indian wars**.

British troops began to control the Indiana region after 1763. During the Revolutionary War (1775-1783), however, the area was defended mostly by local settlers. Virginia troops under George Rogers Clark occupied Vincennes and its stronghold, Fort Sackville, in 1778. A British expedition recaptured the fort, but Clark seized it again in 1779. This victory helped give the Americans control over the Northwest. In 1787, Indiana became part of the Northwest Territory (see **Northwest Territory**).

Territorial days. Indians often attacked the early settlers. The Miami, led by Chief Little Turtle, burned villages and killed many whites. In 1794, federal troops under General Anthony Wayne defeated the Miami and other tribes in the Battle of Fallen Timbers, along the Maumee River near present-day Toledo, Ohio.

Congress created the Indiana Territory in 1800. It included the present states of Indiana, Illinois, and Wisconsin, and parts of Michigan and Minnesota. Vincennes was the capital of the territory. President John Adams appointed General William Henry Harrison the first territorial governor. By the time Illinois became a separate territory in 1809, Indiana had almost the same borders it has today.

In 1809, Harrison bought about 2,900,000 acres (1,170,000 hectares) of Indian lands in southern Indiana for the federal government. But Tecumseh, the famous Shawnee chief, objected to the purchase treaty as unfair

Color lithograph (1889); Indiana Historical Society

The Battle of Tippecanoe took place in 1811 near present-day Lafayette. General William Henry Harrison's troops defeated several Indian tribes led by Shawnee Prophet, brother of the famous chief Tecumseh.

(see Tecumseh). Several tribes banded together, obtained guns and powder from the British, and prepared for war. Harrison defeated the Indians in 1811 in the Battle of Tippecanoe, at present-day Battle Ground. The Indians joined with British forces during the War of 1812 (1812-1815). In 1813, Harrison again defeated the Indians and the British in the Battle of the Thames, at Moraviantown, Ontario. Tecumseh was killed in this battle. These American victories ended British influence in the territory. The Indians stopped their attacks, and the settlers were free to develop the land. Corydon became the new capital of the Indiana Territory in 1813.

Early statehood. On Dec. 11, 1816, Indiana joined the Union as the 19th state. Its population totaled about 64,000. Jonathan Jennings, a Democratic-Republican, became the first governor. The new state government found it had no money except the little taken in by a land tax. But new settlers did not have to pay this tax for five years after buying their land from the federal government. Other farmers had little money with which to pay taxes. They made only small profits from their crops because transportation to eastern markets was expensive and risky.

In 1818, the federal government bought the central part of the state in treaties with the Indians. The government gave the area to Indiana. Soon after this so-called New Purchase, settlers came to central Indiana. In 1824, the legislature made Indianapolis the capital, because of its central location. The legislature moved there in 1825.

In 1825, Robert Owen, a Scottish social reformer, established the town of New Harmony in the lower Wabash River Valley. He hoped to start a new social system, and set up rules for community living. The group included scholars, teachers, and scientists. Under Owen's leadership, the community adopted progressive ideas, especially in education. For a time the colony prospered, and foreign leaders came to study Owen's methods. The experiment failed in 1827, largely because many persons in the group had not cooperated.

During the 1820's, the state received land grants from the federal government to build roads and canals. These developments started a period of wild spending. The state found itself heavily in debt by 1840, and many of the projects were never completed.

William Henry Harrison, Indiana's first territorial governor and the hero of the Battle of Tippecanoe, became president of the United States in March 1841. He died only 30 days after entering the White House.

Indiana's economy improved during the 1850's, when railroads pushed into the state. Cities began to grow, and farmers found new markets for their crops. The Studebaker brothers, Clement and Henry, opened a blacksmith and wagon shop in South Bend in 1852. Their company became the largest wagon manufacturer in the country. Other industries were developed in Indiana. Richard Gatling invented the first practical machine gun in Indianapolis in 1862. During the 1860's, James Oliver invented and improved a hard-steel plow that could easily cut through the tough prairie sod.

The Civil War. During the American Civil War (1861-1865), the only recorded fighting in Indiana took place at Corydon in 1863. General John Hunt Morgan had led his Confederate cavalrymen, called Morgan's Raiders, across the Ohio River from Kentucky. They raided Corydon, and then rode across eastern Indiana into Ohio.

Progress as a state. After the Civil War, Indiana farmers were troubled by debts, low prices for their products, and high freight rates. Prices for farm products did not start increasing until the 1890's. But new industries developed rapidly throughout Indiana during the 1800's. One of the first gasoline pumps in the United States was made in Fort Wayne in 1885. The discovery of natural gas near Portland in 1886 attracted out-of-state industries that wanted to be near this fuel source. In 1889, Benjamin Harrison, a grandson of William Henry Harrison and a resident of Indianapolis, became president of the United States. That same year, the Standard Oil Company built one of the world's largest oil refineries in the little village of Whiting, on Lake Michigan. In 1894, Elwood Haynes of Kokomo designed one of the first successful gasoline-powered cars.

The early 1900's. By 1900, about a third of Indiana's population of more than $2\frac{1}{2}$ million lived in cities. In 1902, the Studebaker brothers' company in South Bend made its first electric-powered vehicles. It began to make gasoline-powered cars in 1904. In 1906, the United States Steel Corporation began building the city of Gary. In addition, the company built its largest steel plant there. In 1911, the first Indianapolis 500 automobile race was held in the Indianapolis Motor Speedway. The state adopted the Workmen's Compensation Act in 1915. This act required employers to pay workers injured on the job.

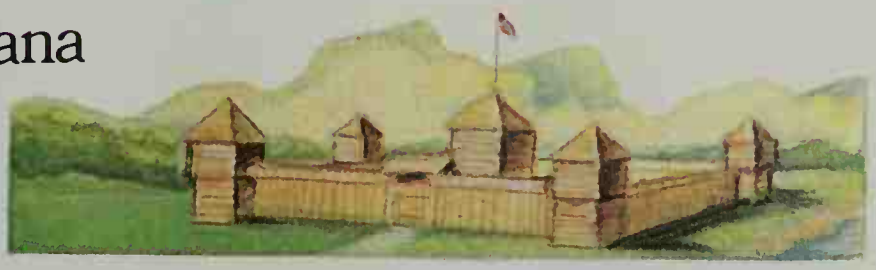
During the 1920's, Indiana's automobile and other metal-products industries expanded rapidly. In 1933, the state reorganized various governmental departments, giving the governor greater powers. In 1937, the state division of labor was created to help deal with labor-management problems. Also in 1937, the Ohio River flooded, causing many deaths and great property damage.

The mid-1900's. In 1940, Governor Henry F. Schricker was the only Democrat elected to an executive state office in Indiana. The next year, the Republican-controlled

Collection of W. S. Huffman, Kokomo, Ind.

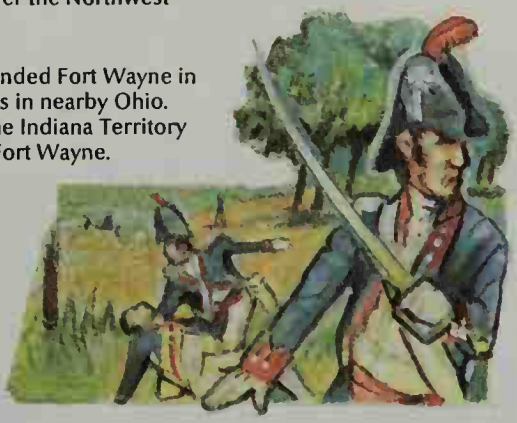
Elwood Haynes designed one of the first successful automobiles. This vehicle was built in Kokomo and first tested on July 4, 1894. Haynes was born in Portland.

Historic Indiana



Fort Sackville was captured by Virginia troops under George Rogers Clark in 1779. This victory helped give the colonists control over the Northwest during the Revolutionary War.

General Anthony Wayne founded Fort Wayne in 1794, after defeating the Indians in nearby Ohio. The fort protected settlers in the Indiana Territory and later grew into the city of Fort Wayne.



Tecumseh formed an alliance of Indian tribes that eventually dissolved after its defeat by William Henry Harrison's forces at the Battle of Tippecanoe in November 1811.

One of the nation's largest steelworks was built by the United States Steel Corporation in 1906 on the site of what is now Gary.

The Port of Indiana in Burns Harbor, which opened in 1970, boosted the state's economy. The Lake Michigan port serves oceangoing ships sailing through the St. Lawrence Seaway.

WORLD BOOK illustrations by Kevin Chadwick

Important dates in Indiana

1679 The French explorer Robert Cavelier, Sieur de La Salle, became the first known white man to reach the Indiana region.

c. 1732 The French founded Vincennes, Indiana's first permanent settlement.

1763 France gave up the Indiana region to Great Britain after the French and Indian War.

1778 Some of George Rogers Clark's men gained control of Vincennes, but the English retook the town. Clark recaptured Vincennes in 1779.

1800 Congress established the Indiana Territory.

1811 William Henry Harrison's troops defeated the Indians in the Battle of Tippecanoe.

1816 Indiana became the 19th state on December 11.

1825 Robert Owen founded the experimental community of New Harmony.

1886 The state's first gas well was drilled at Portland.

1889 The Standard Oil Company built one of the world's largest oil refineries in Whiting.

1894 Elwood Haynes designed one of the first successful gasoline-powered automobiles in Kokomo.

1906 The United States Steel Corporation began building Gary, and put up its largest steel plant there.

1911 The first Indianapolis 500 automobile race was held.

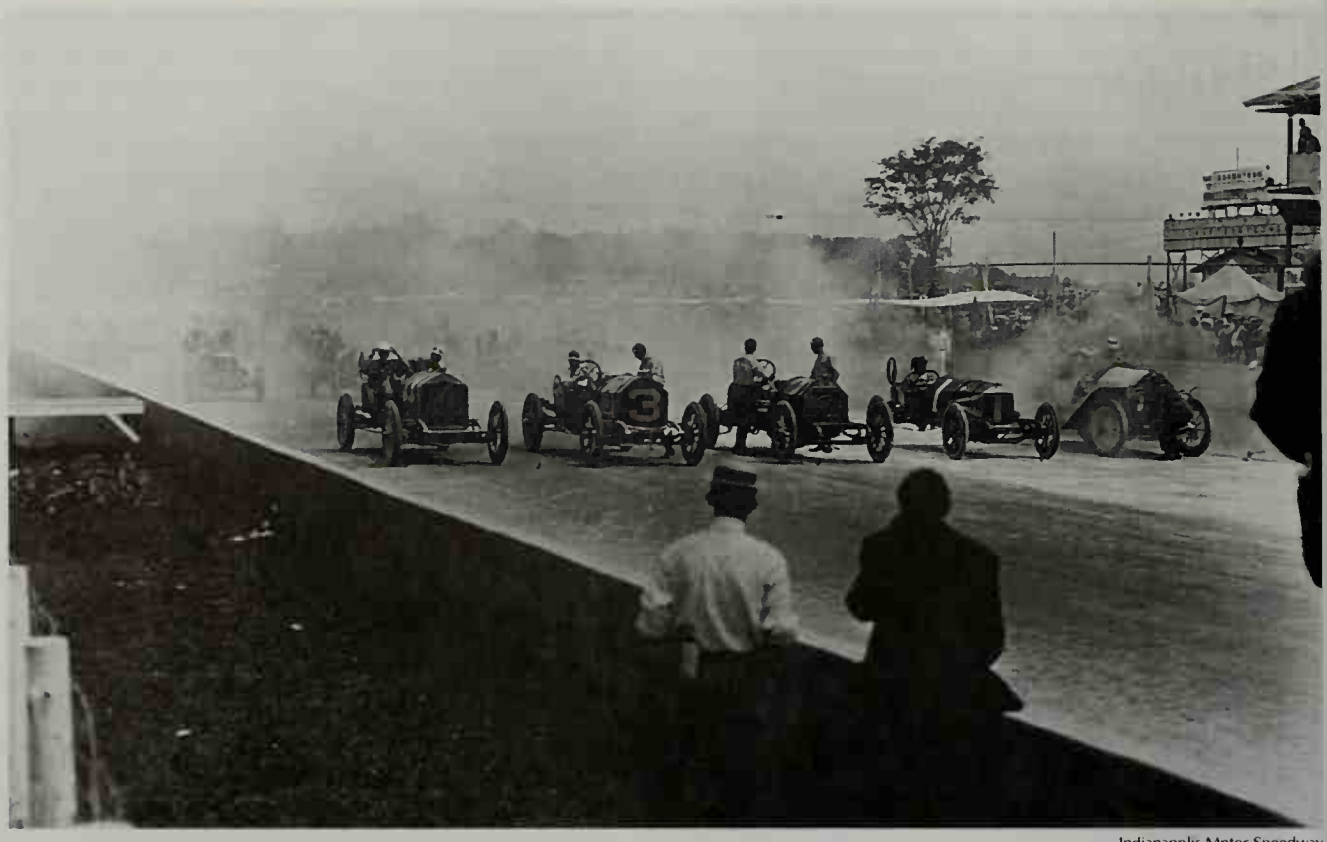
1933 The state government was reorganized, and the governor received greater powers.

1956 Engineers completed the Northern Indiana Toll Road.

1963 The legislature established a retail sales tax. The Studebaker Corporation ended automobile production in South Bend.

1970 Indianapolis and Marion County began operating under a metropolitan government plan called Unigov.

1988 Voters in Indiana approved a state lottery to increase government revenues.



Indianapolis Motor Speedway

The first Indianapolis 500 automobile race was held in 1911 at the Indianapolis Motor Speedway. The race takes place during the Memorial Day weekend and attracts huge crowds.

legislature passed a bill that would have limited much of the governor's authority. But the state Supreme Court ruled the bill unconstitutional.

In 1956, Clifty Creek, one of the nation's largest privately owned power plants, was built in Madison. Also in 1956, the Northern Indiana Toll Road was opened. Indiana continued to shift from an agricultural to an industrial economy during the 1950's and 1960's. The farm population decreased, and the urban population grew. The increased use of farm machinery lessened the need for farmworkers, many of whom moved to cities and took manufacturing jobs. The large industrial cities, including Gary and Indianapolis, also attracted workers from the South.

Indiana generally had been a Republican state since the Civil War. But Democrats gained strength in the cities in the 1960's because most farmers and Southerners who moved to urban areas were Democrats.

In 1963, the Indiana legislature made major changes in the state's tax program. The greatest change was adoption of a 2 percent retail sales tax, the first in Indiana history. Unemployment increased in some parts of Indiana during the 1960's, largely because of automation. Some industries also left the state. Thousands of workers lost their jobs in 1963 when the Studebaker Corporation (now Studebaker-Worthington, Inc.) ended automobile production in South Bend.

In 1970, Indianapolis and Marion County began a reorganization plan called Unigov. The plan combined the local governments and expanded the city boundaries of Indianapolis to take in nearly all the county's 402 square miles (1,041 square kilometers). The reorganization included countywide executive and legislative bodies and combined budgets.

The state experienced major economic growth during the 1970's, aided by the Port of Indiana in Burns Harbor on Lake Michigan. The port, which opened in 1970, serves oceangoing ships by way of the St. Lawrence Seaway. Indiana also faced problems in the 1970's. The costs of government rose sharply, and so the state legislature increased the retail sales tax in 1973. It raised the tax again during the mid-1980's.

In the early 1980's, a recession developed in Indiana. A nationwide decline in the demand for steel, automobiles, and other manufactured goods caused unemployment to rise dramatically in the state's manufacturing sector. In addition, many of Indiana's farmers went into debt or went bankrupt as they faced high operating costs and declining prices for their products. The recession and rising unemployment reduced state tax revenue.

Recent developments. Indiana's economy improved in the late 1980's and the 1990's. The state's agricultural and manufacturing sectors recovered, and growth in the high-technology and service industries made the economy more diversified. Higher rates of both income taxes and sales taxes contributed to an increase in tax revenues. Indiana used this additional revenue to help finance programs to attract new businesses to the state. Indiana also increased its spending on education, and many cities began redevelopment projects. Older sections of Indianapolis that were rebuilt feature new office, government, and university buildings, and hotels and sports facilities. David L. Anderson and Michael E. Sullivan

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Indian, American
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Notre Dame, University of

Outline

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VI. History

Questions

What is Indiana's most valuable farm product?
What are two possible sources of Indiana's famous nickname?
What region of Indiana produces the most steel?
Who was the hero of the Battle of Tippecanoe?
How did Indiana pioneer in public education?
What is the most famous annual event in Indiana?
What is Indiana's most valuable mineral resource?
What famous vacation area is located along Lake Michigan in Indiana?
Where is the center of the Republican Party's strength in Indiana?
What Indiana town remails thousands of letters and packages at Christmastime?

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Indiana State University is a state-supported coeducational school in Terre Haute, Indiana. It has a college of arts and sciences and a graduate school. It also has schools of business; education; nursing; technology; and health, physical education, and recreation. Courses at the university lead to bachelor's, master's, and doctor's degrees.

Indiana State was founded in 1865 as Indiana State Normal School. It became a university in 1965.

Critically reviewed by Indiana State University

Indiana University is a state-supported coeducational institution. The university has three main divisions—the Bloomington campus, Indiana University-Purdue University at Indianapolis (IUPUI), and the regional campus system.

The Bloomington campus is the largest and oldest branch of Indiana University. It has a college of arts and sciences, divisions of continuing education and optometry, a graduate school, and a graduate library school. In addition, there are schools of business; education; health, physical education, and recreation; law; music; and public and environmental affairs. Courses taken at the Bloomington campus lead to bachelor's, master's, and doctor's degrees.

The main library on the Bloomington campus ranks as one of the nation's largest university libraries. Also on the Bloomington campus are the Lilly Library, which has collections of rare books and manuscripts, and an art museum, which houses more than 25,000 art objects. Scientists from around the world conduct research at the university's cyclotron facility, which is located on the campus.

In Indianapolis, Indiana and Purdue universities merged in 1969 to form IUPUI. Students may earn bachelor's, master's, and doctor's degrees from either Indiana or Purdue, depending on their field of study. IUPUI has schools of dentistry, engineering and technology, liberal arts, medicine, nursing, physical education, science, and social service; a graduate school; and divisions of allied health sciences, business, continuing education, education, and public and environmental affairs. Indianapolis Law School and Herron School of Art are also part of IUPUI.

The regional campus system includes a second joint campus with Purdue University in Fort Wayne and campuses in Gary, Kokomo, New Albany, Richmond, and South Bend. Indiana University was founded in 1820.

Critically reviewed by Indiana University

Indiana University

Indiana University's art museum in Bloomington houses a collection that includes thousands of art objects.

Indianapolis is the capital and largest city of Indiana. It ranks as one of the chief centers of manufacturing, transportation, and the distribution of goods in the Midwest. Indianapolis, which lies in the center of Indiana, is one of the largest cities in the United States that is not on navigable water. But it is sometimes called the *Crossroads of America*, because many highway and railroad routes meet there.

Jeremiah Sullivan, who served as an Indiana Supreme Court judge from 1837 to 1846, made up the city's name. He combined *Indiana* with *polis,* the Greek word for *city.* The development of industry and transportation and the city's role as state capital have helped Indianapolis grow steadily.

Indianapolis attracts worldwide attention each year in May. The famous Indianapolis 500 automobile race is held during the Memorial Day weekend. About 400,000 spectators jam the Indianapolis Motor Speedway to watch it. For information about the race, including a table of the winners, see **Automobile racing.**

The city. Indianapolis covers 405 square miles (1,049 square kilometers) in Marion County. The city's outer boundaries are the same as those of the county. But within the city lie four other communities, each with its own government. They are Beech Grove, Lawrence, Southport, and Speedway. Speedway is the site of the Indianapolis Motor Speedway.

The Indianapolis metropolitan area covers 3,523 square miles (9,125 square kilometers). It includes the city, the rest of Marion County, and eight other counties—Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, Morgan, and Shelby.

The White River flows through Indianapolis from northeast to southwest. The downtown, or central business, area of Indianapolis lies near the center of the city, east of the river. The heart of this section is called the Mile Square. It was designed by Alexander Ralston, an architect who helped plan Washington, D.C. In its center is Monument Circle, with the Soldiers and Sailors Monument, which is 284 $\frac{1}{2}$ feet (86.7 meters) high.

Near Monument Circle are the state capitol and the Indiana World War Memorial Plaza, which includes a military museum and the national and state headquarters of the American Legion. Also nearby are Conseco Fieldhouse, used for basketball and other events; the RCA Dome, a domed stadium used for football and other events; and the Indiana Convention Center.

Residential areas spread outward in all directions from downtown Indianapolis. The Mile Square also has a number of modern and restored residential buildings.

People. About 69 percent of the people of Indianapolis are of European ancestry, including English, French, German, and Irish. African Americans make up about a fourth of the population. Small population groups in the city also include people of Asian or Hispanic descent.

Economy. Many manufacturing firms operate in the Indianapolis metropolitan area. The city's chief industry is the manufacture of transportation equipment—automotive and aircraft engines, transmissions, truck bodies, and other vehicle parts. Other important industries in Indianapolis include the manufacture of chemical and pharmaceutical products, computer software, electrical and nonelectrical machinery, electronic equipment, and fabricated metals. Food processing and printing and

Indianapolis Convention & Visitors Association

Indianapolis is Indiana's capital and largest city, and a center of manufacturing and distribution. In this photograph, the downtown skyline serves as a backdrop for the city's pleasant Canal Walk.

publishing are also important economic activities.

Service industries account for the largest part of the city's economic activity. This large economic category includes government activities and wholesale and retail trade. Local, state, and federal government agencies employ a large number of the area's workers. Government projects also create work for other industries. A large technological center, once run by the U.S. Navy, deals with the development, production, and acquisition of electronics used in military aviation.

Indianapolis ranks as one of the Midwest's chief centers for the distribution of goods. Seven legs of interstate highways and several U.S. routes reach the city. Indianapolis International Airport is about 8 miles (13 kilometers) southwest of the city's downtown area. Railroad passenger trains connect Indianapolis and other cities. A number of major rail freight lines and trucking firms also serve Indianapolis. The city has one daily newspaper, *The Indianapolis Star*.

Education. Indianapolis Public Schools is the largest of the dozens of public school systems in the metropolitan area. A board of seven members heads Indianapolis Public Schools. The members of the board are elected to four-year terms. Many private and parochial schools also serve the city.

Indiana and Purdue universities operate a joint campus in Indianapolis. The university complex includes the Indiana Center for Advanced Research; a school of law; and a medical center with schools of dentistry, medicine, and nursing. Other colleges and universities in Indianapolis include Butler University, Christian Theological Seminary, the University of Indianapolis, Marian College, and Martin University.

The Indianapolis-Marion County Public Library system serves the Indianapolis area. The Indiana State Library and the Indiana Historical Society both house collections of material on Indiana history.

Cultural life. The Indianapolis Symphony Orchestra performs at the Circle Theatre. The Indianapolis Opera Company performs at the Murat Theatre. Local and visiting performers present ballets, concerts, operas, and plays at Clowes Memorial Hall on the Butler University

Facts in brief

Population: *City*—791,926. *Metropolitan area*—1,687,486.
Altitude: 710 ft (216 m) above sea level.
Area: *City*—405 mi² (1,049 km²), including 10 mi² (26 km²) of inland water. *Metropolitan area*—3,523 mi² (9,125 km²), excluding inland water.
Climate: *Average temperature*—January, 29 °F (−2 °C); July, 76 °F (24 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—39 $\frac{1}{4}$ in (99.7 cm). For the monthly weather in Indianapolis, see **Indiana** (Climate).
Government: Mayor-council. *Terms*—4 years for the mayor and 4 years for the 29 council members.
Founded: 1820. Incorporated as a city in 1847.

Symbols of Indianapolis. The star on the flag represents the Soldiers and Sailors Monument and the position of Indianapolis as the state capital. The eagle and scales on the city seal symbolize the United States and justice.

campus. The Indiana Repertory Company performs on three stages in the Indiana Theatre.

The Indianapolis Museum of Art contains exhibits of American, European, and Oriental art. The Indiana State Museum features natural history displays, and paintings by Indiana artists. The Children's Museum has exhibits on such topics as natural history, pioneer life, science and technology, and transportation. The collections of the Eiteljorg Museum of American Indians and Western Art focus on the American Indian and the Western United States.

Recreation. About 130 parks cover a total of about 8,000 acres (3,200 hectares) in Indianapolis. Eagle Creek Park, the largest, has about 4,400 acres (1,800 hectares). The Indianapolis Zoo features more than 2,000 animals of about 250 species. The city is the home of a number of sports teams, including the Indianapolis Colts of the National Football League and the Indiana Pacers of the National Basketball Association. The Indiana State Fair, held at the Indiana State Fairgrounds in late summer, attracts nearly a million people yearly.

Other interesting places to visit include:

Benjamin Harrison Memorial Home stands at 1230 N. Delaware Street. Harrison, the 23rd president of the United States, built the house in 1872. He lived there until his death in 1901, except during the years he spent in Washington, D.C.

Conner Prairie Pioneer Settlement and Museum, about 10 miles (16 kilometers) northeast of downtown Indianapolis, stands on the site where the first white settlers of the Indianapolis area lived. It includes a house built in 1823.

Crown Hill Cemetery, at 700 W. 38th Street, contains the graves of President Benjamin Harrison, three vice presidents, and the poet James Whitcomb Riley. The notorious criminal John Dillinger is also buried there.

Indianapolis Motor Speedway and Museum, in Speedway, about 6 miles (10 kilometers) northwest of the downtown area, is the site of the 500-mile (805-kilometer) automobile race. NASCAR and Formula One auto races are also held there. The museum features several cars that won the Indianapolis 500.

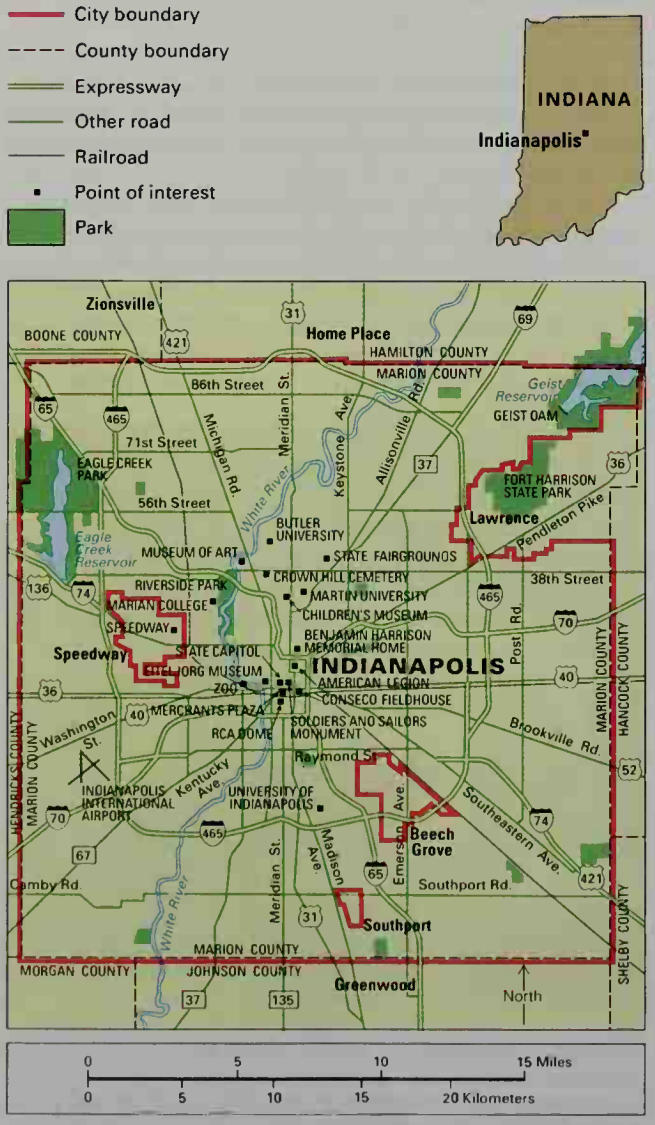
James Whitcomb Riley Home stands at 528 Lockerbie Street. Riley, known as the *Hoosier Poet,* lived there during the last 23 years of his life. Built in 1872, the house contains its original furnishings.

Scottish Rite Cathedral, in downtown Indianapolis, is an impressive example of architecture in the Gothic style.

Union Station, on South Illinois Street, was built in 1888 and has been renovated as a marketplace. It includes shops, restaurants, nightclubs, and a hotel featuring Pullman sleeper cars that have been converted into hotel suites. Union Station also includes an indoor karting track (see **Kart racing**).

Indianapolis

Indianapolis is the capital and largest city of Indiana. Indianapolis covers all of Marion County except for the four municipalities of Beech Grove, Lawrence, Southport, and Speedway.



WORLD BOOK map

Government. In January 1970, Indianapolis and Marion County joined together under a unified government, popularly called *Unigov.* The state law that established Unigov extended the Indianapolis city limits to include all of Marion County except the communities of Beech Grove, Lawrence, Southport, and Speedway. Indianapolis, which formerly covered 82 square miles (212 square kilometers), added about 300 square miles (780 square kilometers) to its area.

Unigov combined about 60 city and county government agencies into 6 departments. These departments are (1) administration, (2) metropolitan development, (3) parks and recreation, (4) public safety, (5) public works, and (6) transportation. Local school districts, the county sheriff's office, and some other county agencies remained independent.

Indianapolis voters elect a mayor and 29 members of the city-county council to four-year terms. Property taxes provide most of the city's revenue.

History. In early 1820, the George Pogue and John McCormick families became the first white settlers in what is now Indianapolis. The two families and a small group of Delaware Indians were the only people living in the area when it was chosen to be the state capital. In June 1820, a commission selected the area because (1) the site lay near the center of the state and (2) the commissioners thought the nearby White River was navigable. They later discovered that the river was too shallow for large boats.

A lack of good transportation facilities limited the early growth of Indianapolis. The rate of growth increased after the state capital was moved to Indianapolis from Corydon in 1825. More growth took place after the National Road (now U.S. 40) reached Indianapolis from the East in 1830. The community had a population of 1,085 at that time. Indianapolis was incorporated as a town in 1836 and as a city in 1847.

German and Irish immigrants began arriving in 1836 to build a canal between Indianapolis and the nearby town of Broad Ripple. The canal was a financial failure, but in 1847, the first railroad reached Indianapolis. By 1855, eight railroads were serving the city. During the mid-1800's, Indianapolis became a market for products from nearby farms. It also became a manufacturing center with companies involved in more than 100 industries, including the manufacture of lightning rods, saws, stoves, and wagon wheels. The population of Indianapolis jumped to 8,091 by 1850, to 18,611 by 1860, and to 48,244 by 1870.

The Indianapolis Stockyards opened in 1877. During the 1880's, the discovery of natural gas in Indiana made cheap fuel available and attracted new industries to Indianapolis. The population of the city reached 169,164 by 1900.

During the early 1900's, automobile manufacturing became a major industry in Indianapolis. The speedway was built in 1909 to test cars, and the first 500-mile (805-kilometer) race was held there in 1911. By 1920, many car manufacturers had moved to Detroit, and no cars were made in Indianapolis after 1937. But within a few years, the transportation equipment industry expanded to meet the demands of World War II (1939-1945). During the 1940's, many people moved to Indianapolis to work in industries that made parts for military vehicles. By 1950, the city's population had increased to 427,173.

Also in 1950, the Western Electric Company began manufacturing telephones in Indianapolis. For many years, more telephones were made there than in any other city in the world. But the company closed its Indianapolis operations in 1986.

Much progress took place in Indianapolis during the 1950's and 1960's. Urban renewal projects were carried out; freeways were built; and new cultural, educational, and scientific facilities were established.

In the 1970's and 1980's, a number of construction projects were completed in downtown Indianapolis. The Indiana Convention Center opened in 1972. Merchants Plaza, which includes a hotel, offices, and a shopping mall, opened in 1977. The RCA Dome (called the Hoosier Dome until 1994) was completed in 1984. Union Station, formerly a railroad station, was remodeled into a marketplace in 1986. New apartment complexes and restored old housing in and near downtown attracted many new residents to the area.

In the 1980's, Indianapolis became a national center for amateur sports. New facilities for swimming and diving, track and field, tennis, gymnastics, bicycle racing, and soccer contests were constructed. Today, the city is the headquarters of many governing organizations of amateur sports, including the National Collegiate Athletic Association (NCAA) and the National Federation of State High Schools.

In the early 1990's, several downtown department stores closed. In the mid-1990's, however, a number of shops returned to the downtown area with the opening of Circle Centre Mall. Robert G. Barrows

See also **Automobile racing**; **Indiana** (pictures).

Indians. See **Indian, American.**

Indicator, in chemistry. See **pH**; **Litmus.**

Indictment, *ihn DYT muhnt,* in law, is a written statement accusing one or more persons of a particular crime. An indictment can be issued only by a grand jury and only for a serious crime. The grand jury must find that there is *probable cause* (reason) to accuse a person of a crime. The word *indictment* comes from the old French word *enditer,* meaning *to make known.* In an indictment, the grand jury *makes known* both the accused and the exact offense. The chairperson of the grand jury and the prosecuting attorney must sign the *true bill* (bill of indictment). No one can be convicted of a greater offense than that charged in the indictment. The form and language of any indictment are prescribed by law. See also **Jury**; **Trial.** James O. Finckenauer

Indies. See **East Indies**; **West Indies.**

Indigestion is a discomfort in the abdomen that most commonly follows eating or drinking too much. It can be a dull or severe pain, or a feeling of fullness that may be relieved by belching or by expelling gas from the anus. Sometimes a painful, burning sensation, called *heartburn,* rises from the stomach toward the neck and mouth after eating. Difficult or impaired digestion is called *dyspepsia.* See **Heartburn**; **Dyspepsia.**

Indigestion also may accompany certain disorders of the digestive system, including peptic ulcer and liver or gallbladder disease. But indigestion is not always related to the digestive organs. For example, it may accompany heart or kidney disease. Indigestion can sometimes be prevented by avoiding rich, highly seasoned foods. Persistent or recurrent indigestion should be treated by a physician. Roberta L. Bondar

See also **Antacid**; **Colic**; **Digestive system.**

Indigo, *IHN duh goh,* is a deep blue dye used to color cotton and wool. It is also called *indigotin.* In past times, this dye was taken from the indigo plant, a member of the pea family that grows chiefly in India. The name *indigo* is a Spanish form of the English word *India.*

Large amounts of indigo began to be produced in South Carolina in the 1740's and in Georgia in the 1750's. The industry disappeared after the American Civil War ended in 1865. Manufacturers began to make synthetic indigo, and the indigo plantations were no longer necessary.

Synthetic indigo is made from aniline, a coal-tar product. The synthesizing process, discovered by the German chemist Adolph von Baeyer in 1880, was first applied in the German dye industry in 1897. It opened up a new field in the making of synthetic dyes. In this process, aniline is mixed with chloracetic acid to form *phenylglycine.* Then, the phenylglycine is heated and treated chemically to transform it into a white paste called *indoxyl.* Indoxyl turns deep blue when air is blown through it. The paste is washed to remove all salt.

Indigo is a *vat dye* (a dye that is insoluble in water). Indigo paste must be treated with an alkaline reducing agent before it can be used as a dye. The chemical reaction turns the paste yellow and makes a substance that will dissolve in water. After a cotton or woolen fabric has been dyed, it is removed from the vat and exposed to air to oxidize it a deep blue that is resistant to removal by water. Howard L. Needles

See also **Dye**; **Flower** (picture: Flowers of prairies and dry plains); **Pinckney, Elizabeth L.**

Indigo bunting is a North American songbird. It breeds in the eastern part of the United States and in southeastern Canada, and it ranges from southern Mex-

WORLD BOOK illustration by John Rignall, Linden Artists Ltd.

Indigo buntings are songbirds. The female, *top,* has brown feathers. During spring, the breeding season, the male, *below,* has a deep blue head and body.

ico to Panama in winter. The bird measures about 5 inches (13 centimeters) long. The breeding male is indigo blue, and the female is brown. In fall, the male looks much like the female but has some blue on its wings and tail.

Indigo buntings live in brushy fields or along forest edges. The female lays three to four pale bluish-white eggs in a nest of grass, weeds, and bark. Indigo buntings help farmers by eating harmful insects and weed seeds. Martha Hatch Balph

Scientific classification. The indigo bunting belongs to the subfamily Cardinalinae of the emberizid family, Emberizidae. Its scientific name is *Passerina cyanea.*

Indium, a chemical element, is a rare, extremely soft, silver-white metal. It does not occur by itself. Most indium is found in, and extracted from, certain zinc ores. Indium is used to coat the bearings of high-speed engines. Oil spreads over the indium in an even layer and makes bearings run smoothly. Indium increases the flow of electric current through the element *germanium.* Traces of indium are added to germanium to make transistors that are used in pocket radios and in other electronic devices. Indium has the chemical symbol In. Its atomic number is 49, and its atomic weight is 114.818. Indium melts at 156.61 °C and boils at 2080 °C. It was discovered in 1863 by Ferdinand Reich and Hieronymus Theodor Richter, of Germany. Raymond E. Davis

See also Element, Chemical (tables).

Individual differences. See Child; Heredity; Personality.

Individual retirement account. See Pension (Individual retirement accounts).

Indo-European languages. See Language (Language families).

Indochina is the eastern half of a long and curving peninsula that extends into the South China Sea from the mainland of Southeast Asia. Indochina consists of the three nations of Cambodia, Laos, and Vietnam.

Indochina has long been a crossroads of peoples and cultures. It has been invaded from what is now Thailand on the west, from China on the north, and from the sea on the east. Most of the people of Indochina originally came from the plains and mountains of central Asia and from southern China. Some of the earliest settlers came from the islands now part of Indonesia. Over the centuries, the crisscrossing moves of many groups have created a checkerboard of ethnic and language groups. The people have never been able to develop much unity or uniformity among themselves.

Independent peoples and states once made up the area. From the 900's to the 1700's, China and Thailand fought for control of Indochina. France gained control of the region in the 1800's and held it until the 1950's. The French called the region French Indochina.

This article deals with Indochina from its beginning until the Geneva Accords—or Geneva Agreements—of 1954, which brought French colonial rule in the region to an end. For details on developments in this region since 1954, see **Vietnam War** and the *History* sections of **Cambodia; Laos**; and **Vietnam.**

Early days

When the peoples of southern China and the northwest sections of the Indochina peninsula moved southward, they encountered a mixed Indonesian-Malay population. The two groups fought. In most areas, the Indo-Malays were forced into the mountains as the invaders from the north took the more desirable areas along the rivers.

The Viets moved into the peninsula from the coastal plains of southern China. A number of small states developed in the delta of the Red River in what is now

Indochina is an area in Southeast Asia that consists of three nations—Cambodia, Laos, and Vietnam. It was ruled by France from the 1800's to the 1950's. Vietnam was divided into the nations of North Vietnam and South Vietnam from 1954 to 1976.

WORLD BOOK maps

northern Vietnam. By about 200 B.C., these states had united to form the kingdom of Nam Viet. In 111 B.C., the Han Empire of China seized control of the area. The Chinese called it Jiao Zhi. For the next thousand years, Vietnam was part of imperial China.

Tai people probably started moving from southern China across northern Southeast Asia from about the A.D. 700's. They conquered the Indo-Malay people, whom they called *Kha,* a Tai word for *slave* or *savage.*

The Khmer entered what is now Cambodia about A.D. 100. They are the ancestors of the present-day Cambodians. The Khmer ruled most of Indochina, from the Gulf of Thailand to China, between the 800's and 1400's. Their empire was famed for its art, architecture, and government. The ruins of its capital, Angkor, still stand.

In 939, during the reign of the Khmer, the Vietnamese regained their independence from China. The Chinese had renamed the country *Annam* (Pacified South) in 679. The Vietnamese resented the name. They revolted and freed their country. They called the new state *Dai Co Viet* (Great Viet State). Although free, it had to make regular payments to China to keep the peace.

A new kingdom. The Khmer began losing their power in the 1300's. In 1353, the kingdom of *Lan Xang* (the million elephants) was established in what is now Laos. It was set up by a Lao noble, Fa Ngum, who had fled to Cambodia as a boy. Fa Ngum and his successors united several small Tai *principalities* (territories ruled by a prince) along the Upper Mekong River into a single state. Over the next century, Lan Xang developed an effective government and military organization. It also developed trade with its neighbors. About 1700, quarreling among powerful groups in the country destroyed its unity. It split into three principalities—Champasak, Vientiane (also spelled Vieng Chan), and Louangphrabang (also spelled Luang Prabang).

The Thai (formerly Tai), Vietnamese, and Burmese invaded the three countries many times during the 1700's. By the early 1800's, Siam (now Thailand) had gained control over the three kingdoms, including nearly all of what is now Laos. The Thai and Vietnamese also took parts of the old Khmer empire until by the mid-1800's it resembled today's Cambodia. A new *dynasty* (line of rulers) came to power in 1802 on the coast of eastern Indochina, where Dai Co Viet—then called *Dai Viet*—had been independent for about 900 years. It called its kingdom Vietnam. It began the modern history of the area.

French Indochina

French influence began to develop in Indochina during the 1800's. French missionaries had been very successful in converting the Vietnamese to Roman Catholicism. Their successes brought occasional reactions from Vietnamese emperors. In 1858, Emperor Napoleon III of France sent an expedition to avenge the murders of some missionaries and to gain a foothold.

France forced the Vietnamese to give up parts of Cochin China (southern Vietnam). Through treaties between 1874 and 1884, France set up protectorates in Tonkin (northern Vietnam) and Annam (central Vietnam). Cochin China became a French colony.

Meanwhile, France had occupied what is now Cambodia in 1863. In Laos, in the late 1880's, French forces confronted Thai forces that had moved into Louangphrabang. In 1893, Siam was forced to sign a treaty that recognized French control over most of what is now Laos. Louangphrabang became a French protectorate, and Champasak and Vientiane formed a French colony.

World War II. When World War II started, the situation in French Indochina changed greatly. When France surrendered to Germany in 1940, Japan took advantage of France's defeat and moved forces into Indochina. The Japanese let the French remain in office, but Japan actually ruled the region. Then, in March 1945, they *interned* (confined) all French authorities and military units.

During the war, Japan persuaded Vietnamese Emperor Bao Dai to declare Vietnam independent and to organize a government friendly to Japan. King Norodom Sihanouk declared Cambodia independent. King Sisavang Vong did the same for Louangphrabang.

Independence. After Japan surrendered on Sept. 2, 1945, the French tried to return to power. In Vietnam, Chinese Nationalist troops accepted the Japanese surrender in the zone north of the 17th parallel. British troops disarmed the Japanese in the southern half of the country. France persuaded King Sisavang Vong of Louangphrabang to declare himself king of a self-governing Laos. France also regained control of Cambodia, and made it self-governing. Both Laos and Cambodia became members of the French Union.

However, another independent government was organized at the same time in Vietnam. This new ruling group was called the Democratic Republic of Vietnam. It was led by a Communist-trained nationalist, Ho Chi Minh, then head of the Revolutionary League for the Independence of Vietnam (Vietminh). French and Vietminh leaders tried to settle their differences peacefully, but failed. In December 1946, war broke out.

The French kept control of the cities in Vietnam, but were never able to regain power in the countryside. By the end of 1953, France was near defeat. When the Vietminh captured the great fortress of Dien Bien Phu on May 7, 1954, after a 56-day siege, it was clear that the war was almost over. See **Dien Bien Phu, Battle of.**

The Geneva Accords

From May to July 1954, Vietminh and French officials held meetings with representatives of the United States, the United Kingdom, China, and the Soviet Union in Geneva, Switzerland. The meetings resulted in the Geneva Accords. These agreements included a cease-fire that ended the war, which is sometimes called the First Indochina War. The agreements provided for the independence of Vietnam. They also confirmed the independence of Cambodia and Laos, which had been recognized as independent in 1953. As a result, French Indochina ceased to exist. The agreements also provided that Vietnam be temporarily divided into North Vietnam and South Vietnam, at the 17th parallel, and called for national elections in 1956 to unify the country.

The elections never took place. North and South Vietnam became divided politically, which led to the Vietnam War (1957-1975). That war is sometimes called the Second Indochina War.

George C. Herring

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Cambodia	Ho Chi Minh	Vietnam
China Sea	Laos	Vietnam War

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Jakarta is the capital, largest city, and commercial center of Indonesia. Modern buildings surround a traffic circle in downtown Jakarta. The Welcome Monument stands in the center of the circle.

Indonesia

Indonesia is a country in Southeast Asia that consists entirely of islands, more than 13,500 of them. The islands of Indonesia stretch across more than 3,200 miles (5,150 kilometers) of tropical ocean along the equator. Indonesia has the fourth largest population in the world. Only China, India, and the United States have more people. Indonesia occupies a strategic position in Southeast Asia, and its political and economic conditions are important to the stability of the region.

Indonesia has an extremely diverse population. Its people belong to about 300 different ethnic groups and speak more than 250 languages. They had no common language until the late 1920's, when Indonesian nationalists provided one by creating a new language called Bahasa Indonesia, a modified form of the Malay language. Bahasa Indonesia, which means *language of Indonesia*, became a force for national unity. Another unifying force is Islam. Most of Indonesia's people are Muslims, and they make up the world's largest Muslim population.

Indonesia is rich in natural resources. Many of its islands were formed by volcanoes, so they are mountainous and rise steeply from the sea. Much of the soil is especially fertile because it contains volcanic ash, which is rich in nutrients. The rich soil supports bountiful fields of rice, and Indonesia ranks among the world's leading rice producers. Other major farm products include coffee, cocoa, palm oil, rubber, spices, and tea. Lush tropical rain forests cover about two-thirds of Indonesia. Teak and other valuable hardwood trees and rare plants and animals live in the forests. Elephants, rhinoceroses, and tigers roam among the trees. Underground lie deposits of oil, natural gas, bauxite, coal, copper, gold, nickel, silver, and tin.

The Netherlands ruled Indonesia during most of the period from the 1600's to 1945. Indonesia declared its independence in 1945 and fought the Dutch until 1949, when they gave up their control.

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Government

National government. The Indonesian government is based on a set of beliefs known as Pancasila. Pancasila consists of five principles: (1) belief in one God, (2) humanitarianism, (3) the unity of Indonesia, (4) democracy based on deliberation and consensus among representatives, and (5) social justice for all people. Sukarno, Indonesia's first president, set forth the principles of Pancasila in 1945 and made it an official state doctrine. Indonesian law requires all religious, professional, and cultural organizations to adopt Pancasila. Some Islamic organizations, however, object to the government's policy of making religious traditions secondary to Pancasila.

The Constitution of Indonesia was written in 1945. According to this document, a body called the People's Consultative Assembly is the highest government authority. The Assembly has 700 members. They include the 500 members of the House of Representatives, Indonesia's legislature. The provincial legislatures choose 135 members of the Assembly. The General Elections Commission, which also reviews election results, appoints 65 members to represent various social and occupational groups. The People's Consultative Assembly normally meets only once every five years.

The House of Representatives meets yearly. The 500 lawmakers in the House serve five-year terms. The voters elect 462 of the members, and the other 38 are appointed from the nation's armed forces. The People's

Consultative Assembly establishes the general direction of government policies, and the House of Representatives enacts laws to carry them out.

The president is chief of state, head of the government, and commander of the armed forces. The president appoints a Cabinet to assist in running the government. The People's Consultative Assembly elects the president to a five-year term. The president is limited to two terms.

Local government. Indonesia has 27 provinces and 3 special territories—Aceh, Jakarta, and Yogyakarta. The provinces are divided into districts and municipalities. These units are further divided into subdistricts and villages. The central government appoints the officials of all local governments except the rural villages from lists of people nominated by regional legislatures. Rural villagers elect their own village officials.

Politics. Until 1998, Indonesia's most important political organization was Golkar. Golkar was a federation of a number of groups, including labor and the military. It was technically not a political party, but it sponsored most of the candidates in elections. Indonesia's laws ensured that Golkar candidates won a majority of seats in the legislature. In 1998, President Suharto, who had dominated the country and its politics since the 1960's, resigned. Following Suharto's resignation, a number of new political parties emerged. The Indonesian Democratic Party of Struggle, which had existed as a party under Suharto, became the main opponent of Golkar, which remained highly influential. Other major parties in Indonesia include the National Awakening Party and the National Mandate Party.

Courts. Indonesia has district courts, high courts, military courts, and special religious courts that handle personal matters among Muslims, such as divorces and inheritances. The highest court is the Supreme Court. It reviews cases appealed from the high courts and settles disputes between courts in different regions or between the religious courts and other courts. The Supreme Court has no authority, however, to overturn laws it finds unconstitutional. The central government appoints judges. There are no juries.

Armed forces of Indonesia have great influence on both civilian and military affairs. The armed forces consist of the Army, Navy, Air Force, and police force. The president is the supreme commander. By law, Indonesian men may be drafted for two years. But in practice, so many people volunteer that no one is drafted.

International organizations. Indonesia belongs to many international organizations, including the United Nations and its specialized agencies. Indonesia is a founding member of the Association of Southeast Asian Nations. Indonesia is a member of the World Bank, which provides loans to poorer nations for economic development, and the International Monetary Fund, which works to improve payment arrangements and other financial dealings between countries. Indonesia also belongs to several other international finance and development agencies, including the Asian Development Bank, the Islamic Development Bank, and the International Finance Corporation.

People

Indonesia has one of the most ethnically diverse populations in the world, with people from about 300 ethnic groups. The largest ethnic group is the Javanese, who live mostly on the island of Java and make up about 45 percent of Indonesia's population. The second largest group is the Sundanese, who live in western Java and make up about 14 percent of the population. The Madurese, who live mostly on Madura, and the Malays each make up about 8 percent of Indonesia's people. The many small ethnic minorities include Arabs, Balinese, Dayaks, and Papuans. People of Chinese descent are the wealthiest ethnic group in Indonesia. Their wealth causes social tension, and they have sometimes become the targets of racial violence.

The people of Indonesia speak more than 250 different languages. Bahasa Indonesia is the official language. Indonesian nationalists created it in the late 1920's, early in the country's struggle for independence, to provide a common tongue for Indonesia's many peoples. Bahasa Indonesia was based on the Malay language spoken in eastern Sumatra, the Riau Islands, and the Malay Peninsula. It resembles Coastal Malay, which was the common language of trade in Indonesian ports. Bahasa Indonesia became the language used in schools and universities. Children learn the language of their ethnic group at home and learn Bahasa Indonesia in school.

Some Indonesians, especially the Javanese, have only one name. They include the country's first two presidents, Sukarno and Suharto.

Jules Bucher, Photo Researchers

The Parliament Building in Jakarta is the meeting place for the People's Consultative Assembly and the House of Representatives.

Indonesia in brief

General information

Capital: Jakarta.
Official language: Bahasa Indonesia.
Official name: Republic of Indonesia.
National anthem: "Indonesia Raya" ("Great Indonesia").
Largest cities: (1989 official estimates)
Jakarta (6,761,886)
Bandung (1,401,108)
Surabaya (2,159,170)
Semarang (1,112,175)
Medan (1,715,670)

Symbols of Indonesia. Indonesia's flag was adopted on Independence Day, Aug. 17, 1945. Red stands for courage, and white for purity. The coat of arms bears the national motto of Indonesia, *Unity Through Diversity*. The motto dates from the 1920's.

Land and climate

Land: Indonesia is made up of more than 13,500 islands that lie along the equator. About two-thirds of Indonesia's land is forested, and much of it is mountainous and volcanic.
Area: 735,358 mi² (1,904,569 km²). *Greatest distances*—east-west, about 3,200 mi (5,120 km); north-south, about 1,200 mi (1,930 km). *Coastline*—22,888 mi (36,835 km).

Chief islands (1996 official estimates)

Island	Area In mi²	Area In km²
Greater Sunda Islands*		
Borneo (Kalimantan)	211,542	547,891
Sulawesi (Celebes)	74,054	191,800
Java (including Madura)	49,228	127,499
Sumatra	186,253	482,393
Lesser Sunda Islands		
Bali	2,175	5,633
Nusa Tenggara (including Flores, Lombok, Sumba, Sumbawa, and West Timor)	26,063	67,502
Molucca Islands	30,066	77,871
Papua (formerly Irian Jaya)	162,928	421,981

*Figures include small neighboring islands

Elevation: *Highest*—Puncak Jaya, 16,503 ft (5,030 m) above sea level. *Lowest*—sea level along the coasts.
Climate: Indonesia has a tropical climate, with hot, humid weather and heavy rainfall most of the year. The average temperature is 80 °F (27 °C).

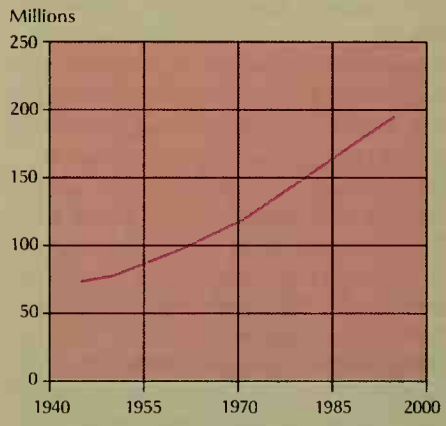
Government

Legislature: House of Representatives, consisting of 500 members.
Executive: President and Cabinet. The Cabinet is appointed by the president, who serves as both head of state and head of government.
Judiciary: Highest court is the Supreme Court.
Political subdivisions: 27 provinces and 3 special territories.

People

Population: *2002 estimate*—217,314,000. *1990 census*—179,378,946.
Population density: 296 per mi² (114 per km²).
Distribution: 61 percent rural, 39 percent urban.
Major ethnic groups: About 45 percent Javanese, 14 percent Sundanese, 8 percent Madurese, and 8 percent Malay. Smaller ethnic groups include Arabs, Balinese, Chinese, Dayaks, and Papuans.
Major religions: About 87 percent Muslim and 10 percent Christian. The remainder are Hindu, Buddhist, or followers of local religions.

Population trend



Year	Population
1945	73,340,000
1950	77,210,000
1961	97,090,000
1971	119,208,000
1980	147,490,000
1990	179,379,000
1995	194,755,000

Economy

Chief products: *Agriculture*—bananas, cassava, cocoa, coconuts, coffee, corn, hogs, palm oil, poultry and eggs, rice, rubber, sheep, spices, sugar cane, sweet potatoes, tea, tobacco. *Fishing*—shrimp, tuna. *Forest industry*—plywood, rattan, teak, timber. *Manufacturing*—cement, chemicals, cigarettes, clothing, fertilizers, footwear, petroleum, processed rubber products, steel products, textiles, and wood products. *Mining*—bauxite, coal, copper, gold, natural gas, nickel, petroleum, silver, tin.
Money: *Basic unit*—rupiah. One hundred sen equal one rupiah.
International trade: *Major exported goods*—coffee, liquefied natural gas, palm oil, rubber, tea, textiles and clothing, tobacco, wood and wood products. *Major imported goods*—chemicals, machinery, mineral products, transportation and electrical equipment. *Main trading partners*—Japan is Indonesia's most important trading partner by far. Other major partners of Indonesia include Australia, Germany, Singapore, Taiwan, and the United States.

Way of life

Rural life. About two-thirds of the people of Indonesia are farmers or agricultural workers who live in small, rural villages. Life in most of these villages, called *desas,* is controlled by village headmen, religious teachers, and other traditional leaders. The village leaders govern by a traditional system that stresses cooperation. The villagers often settle disputes and solve problems by holding open discussions, called *musyawarah,* that continue until everyone reaches an agreement, known as *mufakat.*

Life in small farm villages increasingly combines modern practices with older ways of life. For example, most villagers listen to the radio, shop in nearby towns, and send their children to public school. At the same time, they follow many ancient customs. For example, some villagers still build a traditional type of Indonesian house that stands on stilts about 6 feet (1.8 meters) high. Families use the space underneath for cattle stalls or chicken coops, or to store tools and firewood. The floors and walls are made of timber or flattened bamboo. The roofs are covered with clay tiles, palm thatch, or iron.

Some ethnic groups build large communal houses in which as many as several hundred people may live. These groups include the Dayaks on Borneo, the Toraja on Sulawesi, the Batak on Sumatra, and some Papuan groups on Irian Jaya.

City life. City people live in American- and European-style houses and apartment buildings. Most of the largest cities of Indonesia are on Java. They include Jakarta, Indonesia's largest city by far. Jakarta, Surabaya, and Medan have modern business districts with busy streets, elegant stores, and towering office buildings.

Clothing. The traditional clothing of Indonesian men and women is a colorful skirt called a *sarong* or a *kain.* A sarong is a long strip of cloth wrapped around the body. A kain is similar, but with the ends sewn together. Men wear a shirt with trousers, or a sarong. Women usually wear a long-sleeved blouse and a sarong or kain.

The men often wear a special hat or cap, and women may wear a shawl over their shoulders or on their head. Unlike Muslim women in many other countries, those in Indonesia do not wear a veil over their face. In the cities, most people wear American- and European-style clothes, but some prefer the traditional clothing.

Food and drink. The main food of Indonesians is rice, boiled or fried in various ways and served with a great variety of other foods. Indonesians eat their rice with meat, fish or a fish sauce, or vegetables; or they

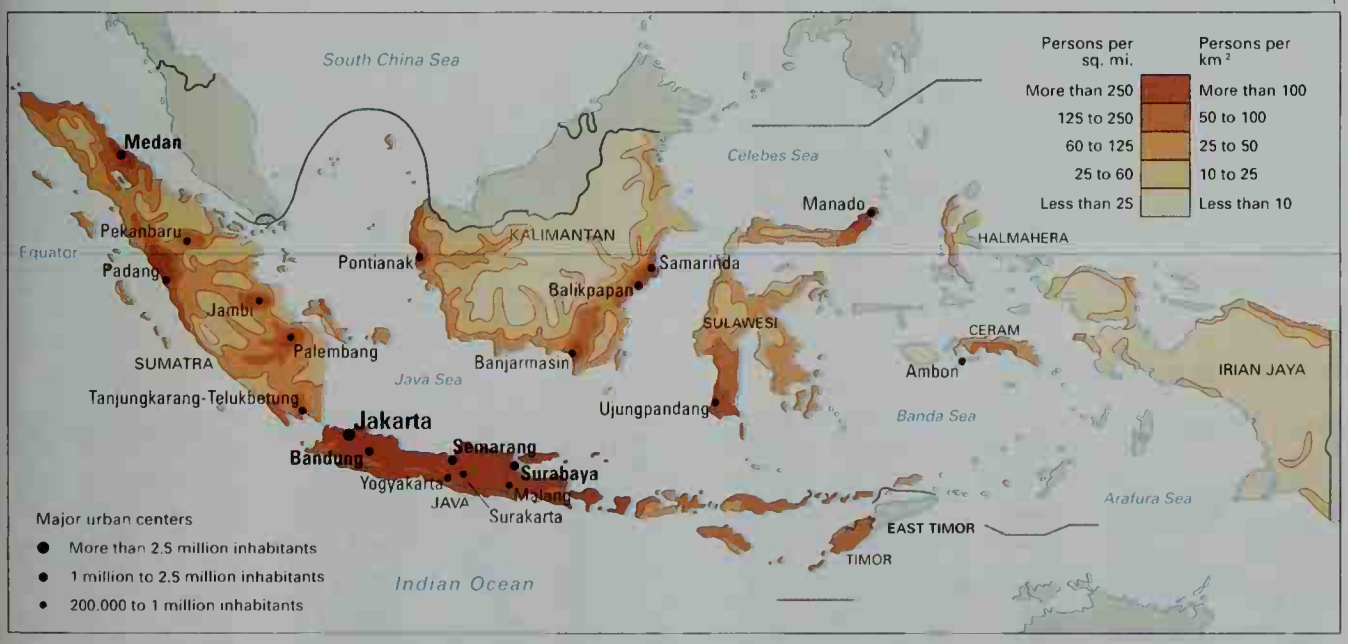
© Jean-Leo Dugast, Panos Pictures

Traditional Indonesian houses, such as this one in a village on Sulawesi, stand on stilts. Families typically use the space underneath for storage or as shelter for farm animals.

Population density

About 60 percent of all the Indonesian people live on the island of Java, though Java accounts for only about 7 percent of the country's total area. Most of Indonesia's largest cities are also on Java. The most thinly populated region is Irian Jaya.

WORLD BOOK map



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								Makassar Strait		E	8					Wowoni Island		F	10

Physical features

Source: 1989 official estimates.

© Chuck O'Rear, Westlight

Television viewing is a popular form of entertainment throughout Indonesia. This photograph shows children watching television in a home in the village of Pabelan, near Mabelang, on Java.

simply flavor it with hot spices. Indonesian cooks often simmer food in coconut milk and oil, and sometimes serve it wrapped in banana or coconut leaves.

The most commonly eaten meats are water buffalo, beef, and chicken. Indonesians eat little pork because most of them are Muslims, and their religion forbids eating it. Tea and coffee are favorite beverages.

People in the cities have a more varied diet than those in rural areas. Many city people eat Chinese, American, and European dishes as well as Indonesian foods.

Recreation. Cockfighting, though outlawed, is a popular recreation in Indonesia, especially on Bali and in the Indonesian part of Borneo, called Kalimantan. On Madura, the people hold bull races and bullfights. A martial art called *pencak silat* is popular throughout Indonesia. Practitioners fight not only with their hands and feet but also with sticks and knives.

Many Indonesians enjoy European and American sports, especially badminton and soccer. Indonesians also like to bicycle, swim, and play tennis and volleyball.

Many people spend their evenings watching television or going to motion-picture theaters. Many movies are American or European films with subtitles in Bahasa Indonesia, but action pictures from Asian countries are also popular.

Religion. More than 85 percent of the Indonesian people are Muslims, and about 10 percent are Christians. Many of Indonesia's Muslims follow Islam less strictly than other Muslims do. For example, many Indonesians combine ancestor and nature worship with Islam or Christianity.

People on Bali and western Lombok follow a religion called Bali-Hinduism. It is based on Hinduism but includes ancient Balinese and Javanese beliefs. The Bali-Hindus worship the spirits of natural features, including mountains and large trees. They also honor the spirits of ancestors which, they believe, visit them. Bali has thousands of Bali-Hindu temples where the religion's many holidays are celebrated with colorful festivals.

Buddhism and Hinduism were important religions on the islands hundreds of years ago. But Indonesia now has relatively few Buddhists or Hindus.

Education. Most of Indonesia's adult population can read and write. For the country's literacy rate, see Literacy (table: Literacy rates). The government provides primary and intermediate schooling for a small fee. The government also helps support private schools. Children are required by law to go to school for nine years, beginning by age 7. Some parts of Indonesia lack enough schools, teachers, or textbooks. But overall, almost all Indonesian children attend primary school, about half attend intermediate school, and nearly one-third go to high school.

Indonesia has about 50 public and private universities. The largest is Gadjah Mada University in Yogyakarta. Only about 4 percent of Indonesia's young people receive a college education.

The arts. The most famous arts of Indonesia include two types of traditional dancing: the dances of the old royal courts of Java and the dramatic folk dances of Bali. Both types of dancers wear elaborate costumes and heavy makeup or masks. Javanese dances consist of slow, elaborate motions in which even finger gestures have a meaning. The dances may represent scenes of adventure, battle, or love. Balinese dances have quicker rhythms and more forceful movements. Many Balinese dances have a religious meaning and are based on ancient Hindu stories.

Wayang (shadow) puppet dramas are a major part of Javanese and Balinese culture. The most popular puppets are flat and made of leather, but wooden puppets

© Photobank

A group of Muslim women gather for outdoor prayers on Java. Indonesia has no official religion, but more than 85 percent of the country's people are Muslims.

© R. Ian Lloyd

Traditional Javanese dancers wear elaborate costumes and make slow, stylized gestures rich with meaning. These dancers are performing a dance drama called the *Ramayana Ballet.*

are also used. The puppeteer sits behind a screen with a palm-oil lamp that throws shadows of the puppets onto the screen. Most *wayang* performances last from late night until early morning.

On Java and Bali, a traditional Indonesian orchestra called a *gamelan* accompanies dances and puppet plays. A gamelan consists chiefly of metal percussion instruments, including gongs, xylophones, and double-ended drums. The orchestra also includes flutes and *rebabs* (two-stringed instruments that resemble lutes).

Beautiful stone sculptures decorate Indonesia's many ancient Buddhist and Hindu temples. Famous temples include the Buddhist complex at Borobudur and the Hindu temples of Prambanan, both in central Java.

Early Indonesian literature consisted largely of local folk tales and traditional Hindu and Islamic stories. Literature became highly developed in many regional languages, especially Javanese. Modern literature written in Bahasa Indonesia began in the late 1920's. Much of modern Indonesian literature is concerned with conflicts between Indonesian and European values and the relationship of traditional Indonesian values to the modern world. Pramoedya Ananta Toer, often considered the greatest Indonesian author, explored these and other themes in his series of four novels about Indonesia's struggle against colonialism. The novels, all published during the 1980's, are *This Earth of Mankind, Child of All Nations, Steps Forward,* and *House of Glass.*

Famous Indonesian crafts include *batik,* a method of waxing and dyeing cloth to make beautifully colored fabrics. Craftworkers also make ceremonial daggers called *krises.* Some Indonesian peoples carve seated wooden figures to represent their ancestors. The Dayaks sculpt objects to ward off evil spirits. The Balinese carve Hindu figures and symbols for their homes and temples.

The islands

People live on more than 6,000 of the 13,500 islands of Indonesia. The rest of the islands are uninhabited. Many geographers divide the islands into three groups: (1) the Greater Sunda Islands, (2) the Lesser Sunda Islands, and (3) the Molucca Islands. Indonesia also includes Irian Jaya, which is part of the island of New Guinea. A table in the section *Indonesia in brief* lists the areas and populations of the chief islands.

The Greater Sunda Islands include Borneo, Sulawesi (formerly called Celebes), Java (also spelled Jawa), and Sumatra (also spelled Sumatera). Most of the Indonesian people live on the Greater Sundas, and most of the nation's economic activity is centered there.

Borneo is the third largest island in the world, after Greenland and New Guinea. The southern three-fourths of Borneo is part of Indonesia. The other fourth consists of the independent nation of Brunei and two Malaysian states, Sarawak and Sabah. The Indonesian part of Borneo is called Kalimantan and is about the same size as France. Tree plantations, natural tropical rain forests, and mountains cover most of Kalimantan. The Kapuas River, the longest river in Indonesia, flows about 700 miles (1,100 kilometers) from the mountains to the sea. The low coastal plains are largely swampy. Kalimantan is thinly populated, and most of the people live along the coast. Banjarmasin is the largest city.

Sulawesi is an island with four long peninsulas. It is the most mountainous island of Indonesia. Mountains in the central region average about 10,000 feet (3,000 meters) above sea level. Many volcanoes, some of them active, rise on the northern peninsula. Forests cover most of the mountain slopes. Some inland valleys and plateaus have fertile farmlands and rich grazing lands. Many of the coastal peoples fish for a living. Makassar is the largest city of Sulawesi and a major seaport.

Java is Indonesia's most densely populated and most industrialized island. It has about 7 percent of Indonesia's total area and about 60 percent of the people. An east-west chain of mountains, including many old volcanoes, extends across the island. Wide, fertile plains lie north of the mountains, with limestone ridges to the south. A large highland plateau covers western Java.

Java's rich volcanic soil supports intensive agriculture. Thousands of small farm villages dot the island. Most of Indonesia's large cities are also on Java, including Jakarta, the capital and largest city. Because Java is so densely populated, the government began a resettlement program in the 1960's to encourage Java residents to move to less crowded islands. Nevertheless, Java's population continues to grow, but more slowly.

Java has 112 volcanoes, some of which are active. The remnants of the island of Krakatau lie off the coast of Java, in the Sunda Strait. In 1883, Krakatau erupted. Much of the island disappeared, and huge, destructive waves called *tsunamis* washed over Java and nearby islands, killing about 36,000 people.

Sumatra is the sixth largest island in the world. The Barisan Mountains, a range of volcanic peaks along the southwestern coast, rise about 12,000 feet (3,660 meters). The mountains slope eastward to a broad plain covered

mostly by tree plantations, tropical rain forests, and some farms. Much of the eastern coast of the island is swampy. To the west, the mountains drop sharply to the sea. Sumatra has rich deposits of oil and natural gas. Medan is Sumatra's largest city.

The Lesser Sunda Islands, which Indonesians call Nusa Tenggara, consist of two strings of islands extending between Bali on the west and Timor on the east. Indonesia controls the western part of Timor. The eastern part of the island is the independent nation of East Timor. Bali has the most people and the largest city, Denpasar. Most other towns in the Lesser Sundas are small, coastal trading centers. The islands have many mountains and rivers.

Timor and other islands in the east have fewer tropical rain forests and more dry grasslands than the islands in the west. Corn is the main crop in the eastern islands, but rice is the principal crop in the western islands.

The Molucca Islands, which Indonesians call the Maluku Islands, lie in the northeastern section of Indonesia. Halmahera, the largest island of this group, covers 6,870 square miles (17,790 square kilometers). Halmahera, Ceram, and Buru are mountainous and thickly forested. The Aru and Tanimbar islands are flat and swampy. The Moluccas also include hundreds of ring-shaped coral reefs called *atolls* and other small coral islands that are uninhabited.

Most of the Moluccan people live in coastal trading settlements. Ambon, an important port on an island of the same name, is the largest city in the Moluccas.

The Moluccas were formerly called the Spice Islands, and they have long been famous for growing cloves, nutmeg, and mace. Through the centuries, the spice trade attracted people from many lands. These traders, including Arabs, Dutch, and Malays, intermarried with the Moluccans and greatly influenced their way of life. On some isolated islands, however, the people have kept many old customs. On the Tanimbar Islands, for example, people still make offerings to their ancestors.

Irian Jaya, sometimes called West Papua, covers the western half of New Guinea and some small islands to the north and west. It was called Irian Barat (West Irian) until 1972, when its name was changed to Irian Jaya (Victorious Irian). The eastern half of New Guinea is part of Papua New Guinea, an independent nation.

Irian Jaya is the least developed and most thinly populated region of Indonesia. Most of the population consists of Pacific Islanders called Papuans. The Papuans belong to a number of ethnic groups, several of whom live in isolated areas and follow traditional ways of life. The Asmat people, for example, live by hunting wild pigs and crocodiles and gathering the pulp of the sago palm.

To ease crowding on other islands, the Indonesian government sponsors a voluntary resettlement program that helps families move to Irian Jaya and other islands. Since the late 1960's, more than 1 $\frac{1}{2}$ million people have moved from Java and Bali to Irian Jaya and other islands under this program.

Tropical rain forests cover about 85 percent of Irian Jaya. Towering mountains extend from east to west through most of the region. These mountains include 16,503-foot (5,030-meter) Puncak Jaya, the highest mountain in Indonesia. Rich deposits of copper and gold lie deep in the mountains. Most of the coastal areas are low and swampy, and some hold pockets of oil. Jayapura, Irian Jaya's largest city, and other towns sit along the coasts. Most of the farmland also lies along the coasts.

© Chris Stowers, Panos Pictures

Rain forests are abundant throughout Indonesia. The forests are rich in fine woods and other commercially valuable products and in wildlife. Some forests are protected nature preserves.

Climate

Indonesia has a hot, humid climate. The average temperature is about 80 °F (27 °C), but temperatures are lower in the highlands. Temperatures vary little throughout the year. As a result, the seasons in Indonesia are based on differences in rainfall, not on changes in temperature. Only Java and the Lesser Sunda Islands have a distinct dry season in which less rain falls. Rainfall is fairly evenly distributed throughout the year in other parts of the country, with heavier downpours in the wet season.

The wet and dry seasons are caused largely by two winds called *monsoons*. From December to March, the winter monsoon blows from the Asian mainland. This monsoon crosses the South China Sea, where it picks up moisture, and brings heavy rains to Indonesia. From mid-June to October, the summer monsoon brings dry air from Australia. West Timor, the part of Indonesia most affected by this wind, has the longest dry season—five months. Borneo and Sumatra, which lie farthest from Australia, have heavy rainfall the year around.

The driest regions of Indonesia are in the Lesser Sundas, which receive from 35 to 40 inches (89 to 102 centimeters) of rain per year. The wettest islands, Borneo and Sumatra, get 120 to 145 inches (305 to 368 centimeters) per year. Some mountainous areas on Irian Jaya receive about 250 inches (635 centimeters) annually.

Economy

Indonesia's economy is a mixed one, with both privately owned firms and state-owned enterprises. About half of Indonesians work in agriculture and fishing, but diversified manufacturing has become a mainstay of the economy.

Service industries, which produce services rather than goods, have become increasingly valuable to Indonesia's economy. Indonesia's main service industries include banking, government, trade, and transportation. Tourism is also an important source of income to Indonesia. Visitors flock to the island of Java to see its beautiful scenery and famous temples, and to Bali, which is renowned for its dancing and colorful festivals.

Manufacturing. Manufactured products account for more than half of Indonesia's export earnings. The major industries include the manufacture of chemicals, garments and footwear, plywood and other wood products, steel products, and textiles. Other important Indonesian manufactured goods include cement, cigarettes, electronic equipment, fertilizers, pharmaceuticals, processed rubber products, and pulp and paper. Some plants assemble automobiles, motorcycles, and light airplanes using a combination of imported and Indonesian-made parts and machinery.

Most manufacturing plants are on Java. Jakarta and Surabaya are the leading industrial centers.

Agriculture continues to be a major economic activity that employs about half of Indonesia's people. Indonesian farmers grow a large variety of crops, helped by fertile volcanic soil, a tropical climate, and plentiful rainfall. Many Indonesian farms are large plantations where workers raise crops for export, such as cocoa, palm oil, rubber, spices, sugar cane, tea, and tobacco.

Rice, the chief food crop, is grown mostly on small farms. Indonesia's government was an early supporter of the Green Revolution, an effort to boost grain production that began in the 1960's. As a result, Indonesian farmers have long planted high-yielding varieties of rice. The farmers on Java grow most of Indonesia's rice. They irrigate their fields with water from mountain streams and produce at least two rice crops a year.

Besides rice, small farms produce bananas, cassava, cloves, coconuts, coffee, corn, fruit, peanuts, soybeans, spices, and sweet potatoes. Farmers generally grow crops for sale as well as for their own use. Their major cash crop is rubber. Many farmers also raise cattle, goats, hogs, poultry, sheep, and water buffalo.

On several Indonesian islands, farmers practice *slash-and-burn agriculture,* also called *shifting cultivation.* They cut down forest trees and burn them, then plant crops in the clearing. The ashes from the burned trees enrich the soil. The farmers raise crops on the same land for only a few years. When the soil begins to wear out, they move.

Mining. Indonesia is one of the world's largest producers of oil and natural gas and the world's largest exporter of liquefied natural gas. Most of the country's petroleum comes from East Kalimantan and Sumatra. Pertamina, a state-owned company, is responsible for the production of petroleum and natural gas. Indonesia is also a leading copper- and tin-mining country. Irian Jaya is believed to hold the world's richest copper ore deposits. The islands of Bangka and Belitung have many tin mines. Indonesia's other mineral products include bauxite, coal, gold, nickel, silver, and tin.

Fishing industry. Fishing is a growing industry in Indonesia, and many kinds of fish are caught in Indonesian waters. Fishing crews take anchovies, mackerel, sardines, tuna, a fish related to pompano called scad, and other fish from the sea. People raise milkfish and prawns in coastal ponds, and a variety of freshwater fish in inland ponds. Fish provide a major part of coastal people's diet. Shrimp and tuna are Indonesia's most important seafood exports.

Forestry. Indonesia has abundant forests that are rich both in commercially valuable products and in wildlife. Forests cover about two-thirds of the country. More than two-thirds of the forested area is used for commercial purposes. About 10 percent consists of nature preserves or protected areas of tropical rain forest. Indonesia's chief forest products include teak, timber, and plywood. Other products from Indonesia's forests include bamboo; mangrove bark, which is used to make dyes; and cinchona bark, which is used to make the malaria drug quinine. Most of the quinine used today comes from Indonesia.

Most of Indonesia's wood products come from Kalimantan and Sumatra. Poor inland transportation has hampered the development of lumbering in other areas.

Energy sources. Petroleum and natural gas provide about 85 percent of Indonesia's energy needs. Coal supplies about 10 percent, hydroelectric power about 3 percent, and geothermal power about 1 percent. Power plants in Indonesia are government-owned.

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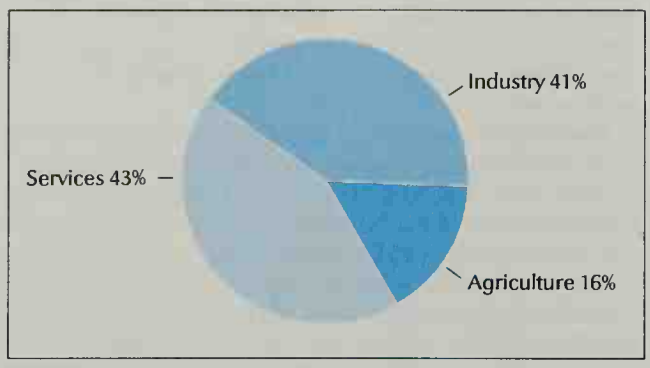
Rice is Indonesia's chief food crop. Much of it is grown in terraced fields, such as these. Indonesian farmers have boosted rice production by planting high-yielding varieties of the crop.

Indonesia's gross domestic product



Indonesia's gross domestic product (GDP) was about $227,370,000,000 in 1996. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, government, and personal services; finance, insurance, real estate, and business services; trade, restaurants, and hotels; transportation and communication; and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, forestry, and fishing.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers	
		Number of people	Percent of total
Manufacturing	25	10,773,000	13
Trade, restaurants, & hotels	17	16,103,000	19
Agriculture, forestry, & fishing	16	37,720,000	44
Community, government, & personal services	11	11,729,000	13
Construction	8	3,796,000	4
Mining	8	774,000	1
Transportation & communication	7	3,943,000	5
Finance, insurance, & real estate	7	690,000	1
Utilities	1	164,000	*
Total	100	85,692,000	100

*Less than one-half of 1 percent.
Figures are for 1996.
Sources: Indonesian Bureau of Statistical Information Systems; International Labour Office.

International trade. Indonesia is the world's largest exporter of liquefied natural gas. Oil and gas account for about 25 percent of Indonesia's total export earnings, down from more than 80 percent in the early 1980's.

Wood products, especially timber, are Indonesia's most important export after petroleum and natural gas. Indonesia once exported many valuable hardwoods, including ebony and teak logs. By the 1980's, such trees were becoming depleted. As a result, Indonesia shifted from exporting logs to exporting processed wood products, including plywood, sawn timber, rattan, and wooden furniture. Rubber ranks as Indonesia's chief agricultural export. Other major exports include coffee, palm oil, tea, textiles, and tobacco. Major imports include chemicals, machinery, mineral products, and transportation and electrical equipment.

Japan is Indonesia's most important trading partner by far. Other major partners include Australia, Germany, Singapore, Taiwan, and the United States. Indonesia belongs to the World Trade Organization, an international organization that promotes trade between nations.

Transportation and communication are difficult in much of Indonesia because of the thick forests and rugged mountains, and the wide stretches of sea that separate the islands. Less than 1 percent of all Indonesians own an automobile. Buses and six- to eight-seat vehicles called *bemos* pick up and let off passengers along most roads. There are good networks of roads on Java, Sumatra, and Bali. On most of the other islands, however, traffic must travel along jungle tracks or by riverboat. Railroads, which are owned by the government, operate on Java, Madura, and Sumatra.

A shipping company owned by the government handles most transportation among the islands. Local vessels also carry passengers and freight. Tanjung Priok, near Jakarta, is Indonesia's leading port.

A government-owned airline called Garuda Indonesia provides international and domestic air service. Another government-owned airline and several private airlines also fly within Indonesia. The main airport is Sukarno-Hatta International Airport at Cengkareng, near Jakarta.

The government operates Indonesia's postal, telegraph, and telephone systems. The government also runs the major radio and television stations. Several privately owned radio and TV stations also broadcast programs. A satellite communications system enables radio and TV programs to reach all of Indonesia's provinces. Many families have a radio or a television set.

Indonesia has approximately 60 daily newspapers and 90 weeklies. The most important daily papers include *Pos Kota* and *Kompas,* both published in Jakarta.

History

Ancient times. Scientists have found fossilized bones on Java of one of the earliest species of prehistoric human beings. This species, called *Homo erectus,* may have lived there as long as 1 $\frac{1}{2}$ million years ago. See Java fossils.

As early as 2,500 B.C., the ancient Indonesians made tools and ornaments of bronze or iron, wove cloth, and sailed the sea. They traded wherever they went, and established trade routes among the islands and with the Asian mainland. Gradually, the islands became a crossroads for commerce between Arabia and China. Merchants of many lands—Arabs, Chinese, Indians, and Persians—came to Indonesia for its spices and other riches.

Hindu and Buddhist kingdoms were rivals for power in Indonesia for hundreds of years. The first strong kingdom was a Hindu state called Mataram, established in central Java in the A.D. 700's. It soon fell to a Buddhist kingdom led by a line of rulers called the Sailendras. The Sailendras lost control of Java in the 800's. Through marriage, they reappeared as rulers of a powerful Buddhist kingdom called Srivijaya, which had developed in Sumatra during the 600's. Srivijaya became the region's leading sea power. A new Hindu kingdom, also called Mataram, replaced the Sailendras in Java. Mataram and Srivijaya became bitter rivals.

In 1293, Prince Widjaya founded a kingdom called Madjapahit. Madjapahit became the first Indonesian kingdom to base its power on both agriculture and commerce. It conquered many other Indonesian lands and ended Srivijaya's power. In the 1300's, Madjapahit claimed most of the islands.

© R. Ian Lloyd

Borobudur, a magnificent Buddhist monument near Yogyakarta, is a popular tourist attraction. It was probably built in the 700's and 800's by the Buddhist rulers of the Saliendra kingdom.

The spread of Islam. Muslim traders from Arabia and India were among the first people to bring Islam to Indonesia. But the religion's main influence came later from Melaka (also spelled Malacca), a port kingdom on the southwestern coast of the Malay Peninsula.

During the early 1400's, Melaka gained control of the important trading route through the Strait of Malacca, between Malaya and Sumatra. Melaka became a great warehouse center. Its ruler converted to Islam, and the religion spread to various parts of Indonesia.

The Madjapahit kingdom fell in the early 1500's. A new Muslim kingdom—the third kingdom in Indonesia to be called Mataram—arose on its ruins. Mataram re-established a united kingdom in central and eastern Java.

The coming of the Europeans. In 1497 and 1498, the Portuguese explorer Vasco da Gama sailed around Africa and discovered a sea route from Europe to India. Other Portuguese explorers soon followed. The Portuguese captured Melaka in 1511, built a fort there, and tried to take over the profitable Indonesian trade.

By the end of the 1500's, the English and Dutch began to challenge the Portuguese for control of Indonesia's riches. England and the Netherlands each formed an East India Company to trade in the region, the English in 1600 and the Dutch in 1602. In 1641, the Dutch captured Melaka from the Portuguese.

Dutch rule. In 1677, the ruler of Mataram on Java asked the Dutch to help him fight a rebel uprising. The Dutch did so, and he gave them important trading rights and Javanese territories. In similar ways, or by force, the trade on other Indonesian islands passed into Dutch hands. By the late 1700's, the Dutch East India Company controlled commerce on most of the islands. The region became known as the Dutch East Indies or the Netherlands Indies.

The Dutch East India Company forced the Indonesians to produce certain crops and deliver them at prices set by the company. The company made enormous profits at first. But its costs grew rapidly during the late 1700's, and it went bankrupt. Legislation by the Dutch government in 1798 caused the company to disband the next year. The government took over the company's land.

At first, the Dutch government established effective political control mainly on Java. Beginning in 1830, the Dutch government forced peasants throughout Java and in parts of Sumatra and Sulawesi to grow such export crops as indigo and coffee on much of their land. The Dutch government collected these crops and made large profits from their sale. In 1870, it permitted Dutch investors to lease farmland in the region. In the next 30 years, many privately owned Dutch plantations went into operation, most of them on Sumatra. The Dutch government gradually extended its control throughout the East Indies, partly by conquest and partly through agreements with local rulers. By about 1910, the final extent of the Netherlands Indies had been established.

The rise of nationalism. Indonesians in several areas had long resisted Dutch rule. In 1825, a major revolt began on Java under Diponegoro, a Javanese prince. Fighting continued until the Dutch crushed the revolt in 1830.

Budi Utomo, the first nationalist organization, was founded in 1908 and won support among well-educated Javanese. It was a cultural association rather than a political party. In 1912, the Islamic Association, originally a Javanese trading society, became political and developed into a serious challenge to the Dutch. To quiet nationalist demands, the Dutch set up a People's Council with some Indonesian representatives on it. But the council had little power beyond that of debate. The Indonesian Communist Party, formed in 1920, led a series of minor revolts in 1926 and 1927. Many other anti-Dutch parties also developed, including the Indonesian National Party, founded in 1927 by Sukarno.

Independence. On Jan. 11, 1942, during World War II, Japanese forces landed in the Netherlands Indies. On February 27, the Japanese defeated an Allied fleet in the Battle of the Java Sea. In the world war, Japan fought on the side of Germany, Italy, and the other Axis nations, and the Netherlands sided with Britain, the United States, and the other Allies. The Japanese occupied the Netherlands Indies on March 7, and the Allies surrendered the next day. Many Indonesian nationalists cooperated with the Japanese but continued to work for independence. On Aug. 17, 1945, after Japan had agreed to surrender to the Allies, Sukarno and other nationalists declared Indonesia's independence. Sukarno became the nation's first president.

The Dutch tried to regain control of Indonesia. From 1945 to 1949, there were periods of fighting and a series of truces. The Dutch recaptured much territory but could not defeat the Indonesians. For the many peoples of Indonesia, the revolution strengthened their belief in nationalism and their sense of Indonesian identity. Under pressure from the United States and the United Nations (UN), the Dutch finally agreed to grant independence to all the Netherlands Indies except West New Guinea (now Irian Jaya). That territory's future was to be decided at later conferences. The Netherlands formally recognized Indonesia's independence on Dec. 27, 1949.

Important dates in Indonesia

A.D. 600's-1200's The Buddhist kingdom of Srivijaya expanded from Sumatra and became a great sea power.
1300's The Hindu kingdom of Madjapahit controlled much of Indonesia.
1400's Islam spread throughout the islands.
1602 The Dutch East India Company was formed.
1620's The Dutch began to control trade in areas of Indonesia.
1799 The Dutch government took over the lands controlled by the Dutch East India Company.
1908 Indonesians began to form nationalist groups.
1942-1945 Japanese forces occupied Indonesia during World War II.
1945 Indonesia declared its independence, and Sukarno became president.
1949 The Dutch recognized Indonesia's independence.
1963 West New Guinea (now Irian Jaya) came under Indonesian control.
1966 Suharto took over much of Sukarno's power and began to reorganize the government.
1968 Suharto was named president.
1976 Indonesia annexed the Portuguese colony of East Timor.
1998 Following protests in Jakarta and other cities, Suharto resigned as president.
1999 Indonesia ended its claim to East Timor.

Indonesia under Sukarno faced serious problems. Only the natural resources needed by the Dutch had been developed. Transportation systems were inadequate. About 90 percent of the population could not read or write, and few people were qualified for high positions in government or business. Regional and ethnic differences threatened to divide the country. There was little agreement on how to solve Indonesia's serious economic and social problems. Parliamentary elections, held in 1955, continued the political confusion by failing to produce a majority party. Revolts broke out on Sumatra and Sulawesi in 1958, but Indonesian Army units from Java defeated all the rebels by 1961.

In 1960, Sukarno dissolved the elected parliament and appointed a new one. He called his system of government "guided democracy." In 1963, the People's Consultative Assembly declared him president for life.

Sukarno had repeatedly demanded that the Netherlands turn over Irian Jaya to Indonesia and threatened to seize it by force. In 1962, the Netherlands gave temporary control of Irian Jaya to the UN, which gave Indonesia responsibility for administering the area. In 1969, the West Irians voted to remain part of Indonesia, and the UN recognized Indonesia's control of Irian Jaya.

In 1963, the country of Malaysia was established over Indonesia's opposition by combining the British colonies of North Borneo (Sabah) and Sarawak with Malaya and Singapore. Indonesia claimed that the United Kingdom had granted Malaysia a false independence and kept the real power. Indonesia also declared that the British had forced North Borneo and Sarawak to join the new nation. Sukarno threatened to crush Malaysia. In 1964, he sent Indonesian forces into the new nation. They were unsuccessful, chiefly because of British military support for Malaysia. In 1965, Sukarno withdrew Indonesia from the UN to protest Malaysia's election to the UN Security Council.

The fall of Sukarno. Sukarno succeeded in giving his people a sense of national identity and pride. But the Sukarno government mismanaged Indonesia's economy, and the country almost went bankrupt. Beginning in 1957, Indonesia seized many foreign-owned plantations and industries, but it did not have enough trained people to run them. Most of the plantations and industrial plants came under the control of Army administrators. Sukarno spent huge sums on such projects as monuments and sports stadiums, but he neglected the development of natural resources. The country's exports fell, and its debts rose. Inflation drove prices up sharply.

During the 1960's, the Indonesian Communist Party gained strength. Communists controlled labor unions and other key organizations, but they held few government posts. In 1965, military officers associated with the Communist Party tried to overthrow the government. They killed six generals and some other officers. The Army, led by Lieutenant General Suharto, quickly defeated the rebels. Over the next several months, civilian mobs retaliated against the Communists, killing more than 200,000 people.

Indonesia under Suharto. In 1966, pressure from the Army and student groups forced Sukarno to transfer much of his power to Suharto. Suharto outlawed the Communist Party, dismissed many government officials, and appointed new ones. He ended Indonesia's opposition to Malaysia and brought Indonesia back into the UN. By 1967, Sukarno had lost his remaining power, and Suharto became acting president. The next year, the People's Consultative Assembly elected Suharto president. The Assembly reelected Suharto as president every five years from 1973 to 1998.

When Suharto became president, Indonesia's economy was weak. The country could not grow enough rice to feed its people, foreign banks would not lend money to the Indonesian government, and the inflation rate was about 1,000 percent a year. Suharto's government, backed by a strong military, created economic and political stability. The government received large amounts of foreign loans and investment. It funded projects to increase rice production, and yields rose sharply. The government also improved health conditions in Indonesia and helped raise living standards in other ways.

Indonesia invaded East Timor, a Portuguese colony, in

© Paula Bronstein, Gamma/Liaison

Student protesters scale the Parliament Building in Jakarta in May 1998 during widespread demonstrations against President Suharto. Suharto resigned shortly after this picture was taken.

1975 and annexed it the following year. Many people of East Timor objected to Indonesian rule, and the UN refused to recognize the annexation. In a UN-sponsored referendum held in August 1999, the East Timorese voted overwhelmingly for independence from Indonesia. In October, the Indonesian People's Consultative Assembly voted to end Indonesia's claim to East Timor. The UN then set up an interim administration in East Timor. In 2002, East Timor became independent.

During the late 1960's and throughout the 1970's, several uprisings broke out in Irian Jaya. The rebels, who called themselves the Free Papua Movement, opposed Indonesian rule. Indonesian government troops largely put down the uprisings, but some fighting along the border with Papua New Guinea continued.

The fall of Suharto. Opposition to Suharto gained strength in the mid-1990's. Many people criticized the Suharto family's immense wealth and its control of key government agencies and economic enterprises. Corruption in government also drew criticism.

In 1997 and 1998, Indonesia suffered one of the worst financial slumps in its history. The value of its currency fell, and its stock market plunged. Banks and other businesses failed, and millions of people lost their jobs. The economic downturn led to renewed calls for Suharto to step down. Violent protests broke out in Jakarta and some other major cities. In May 1998, Suharto resigned. Vice President B. J. Habibie succeeded him.

Recent developments. In June 1999, the Indonesian Democratic Party of Struggle, led by Megawati Sukarnoputri, received the largest number of votes in elections for the House of Representatives. Megawati is a daughter of Indonesia's first president, Sukarno. In October, the People's Consultative Assembly, the body that elects the president, chose Abdurrahman Wahid as president and Megawati as vice president. Wahid headed the National Awakening Party and an alliance of other Islamic parties.

Encouraged by the Indonesian government's decision to end its claim to East Timor, groups in Aceh and Irian Jaya renewed their calls for independence for those regions. In 2000, Christians and Muslims engaged in a series of bloody clashes in the Molucca Islands, and ethnic violence rocked Borneo in 2001.

Wahid faced growing criticism of his administration, as well as corruption charges. Indonesia's parliament threatened to throw him out of office, and he, in turn, threatened to disband the parliament. In July 2001, a special session of the People's Consultative Assembly voted to remove Wahid from office. Megawati became the country's new president.

Dwight Y. King

Related articles in *World Book* include:

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Banjarmasin
Jakarta
Surabaya

History

Dutch East India Company
Raffles, Sir Thomas Stamford
Suharto
Sukarno
World War II (The war in Asia and the Pacific)

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Association of Southeast Asian Nations
Batik
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Borneo
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Dayaks
East Timor
Komodo dragon
Krakatau
Mythology (Jensen's theory)
New Guinea
Organization of the Petroleum Exporting Countries
Sculpture (The Indian influence)

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Questions

How do monsoons affect the climate of Indonesia?
What are some of Indonesia's major mining products?
How did Islam spread to Indonesia during the 1400's?
On which island do about 60 percent of the Indonesians live?
What is the main food of Indonesians?
Why is much of Indonesia's soil especially fertile?
When did Indonesian nationalism begin to develop?
How many islands make up Indonesia?
What is a *gamelan? Batik?*
Why is transportation difficult in Indonesia?

Additional resources

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Inductance is a property of an electric circuit that opposes any change in the current flowing in that circuit. A magnetic field surrounds every electric current. According to a principle of physics known as *Lenz's law,* this magnetic field acts to oppose changes in the electric current. Inductance refers to the reaction of the circuit to this magnetic field opposition.

Inductance has no effect on a steady direct current because the magnetic field around the conductor carrying this current does not change. But if the current flow changes or alternates, the magnetic field also changes. This changing magnetic field *induces* (creates) a voltage in the conductor that opposes any additional increase or decrease in the flow of current.

Inductance that occurs in one circuit is called *self-inductance,* and inductance between two circuits is *mutual inductance.* If a wire carrying a current is wound into a coil, the inductance is increased. Such a coil is known as an *inductance coil* or a *choke coil.* Its inductance

can be further increased by inserting an iron core into the coil. Inductance is measured in units called *henrys.*

Electrical engineers use inductance coils to control electricity. For example, because inductance opposes the flow of alternating current, an inductance coil can serve as a filter to keep alternating current out of direct current circuits. Inductance coils are also used in tuning circuits in radio or television receivers. Lynn W. Hart

See also **Henry; Lenz's law.**

Induction, Electric, is the process by which an electrically charged object charges another object without touching it. It is caused by *electrostatic attraction,* the attraction that opposite electrical charges have for each other. Electrostatic attraction differs from electromagnetic induction, the force produced on an electrically charged particle by a changing magnetic field.

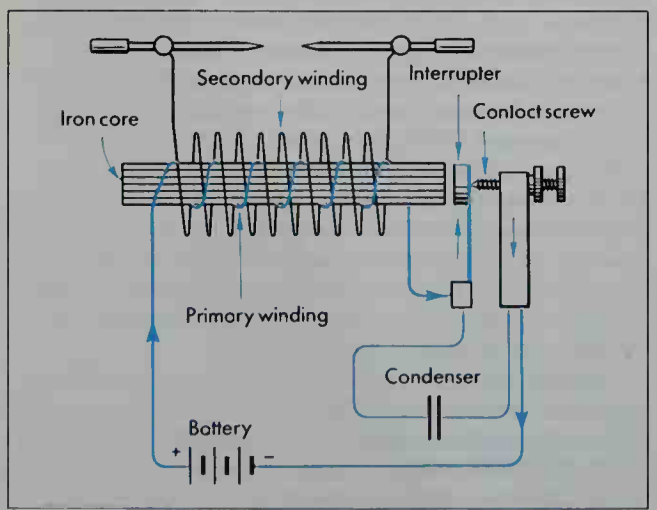
Electric induction can be used to charge a metal object supported by an insulator. For example, a glass rod rubbed with silk will become positively charged. If it is brought near—but does not touch—the insulated metal object, the rod pulls electrons in the metal to the side of the object nearest the rod. The opposite side of the object then lacks electrons. If the opposite side is momentarily connected to the ground, electrons will flow into the object and neutralize the positive charge on that side. After the ground connection and the glass rod are removed, the metal object retains the excess negative charge it received by induction.

The Van de Graaff generator is a machine that uses electric induction. In it, a moving insulating belt charges a hollow metal dome to many million volts. This high voltage is used to accelerate charged particles used in nuclear physics experiments. Lynn W. Hart

See also **Van de Graaff generator.**

Induction coil is an electrical transformer that produces high-voltage alternating current from lower voltage current. An induction coil has two windings of wire—a primary winding and a secondary winding that has more turns of wire than the primary one. If the current flowing in the primary winding is interrupted repeatedly, it creates a changing magnetic field around both windings. This changing field causes an electric current to flow in the secondary winding because of *electromagnetic induction* (see **Electromagnetism**). The voltage in this winding is much higher than that in the primary winding. This is because there are more turns of wire in the secondary winding for the field to act on.

A simple induction coil



The way the current supplied to the primary winding is interrupted depends on the type of coil. In induction coils used to fire the spark plugs in some automobile engines, for example, the primary current is interrupted by mechanical breaker points that are opened and closed by the car's distributor. In induction coils used to ignite gas stoves, jet engines, and oil burners, the primary current is broken by a magnetic vibrator similar to the type used in doorbells. Some induction coils use a transistorized electronic circuit to interrupt the primary current. Douglas M. Lapp

See also **Transformer; Ignition.**

Inductive method is the reasoning process by which a person starts from particular experiences and proceeds to generalizations. A person may start with experiences of eating apples that all tasted sweet. From these experiences, the person may conclude that all apples are sweet. But the next apple may not be sweet. Inductive method leads to probabilities, not certainties. It is the basis of the common sense upon which people act.

Inductive method is also used together with *deduction* to make scientific discoveries. In deduction, people draw particular conclusions by reasoning from general premises (see **Deductive method**). To make discoveries, scientists first obtain general theories by using induction. From these general theories, they then deduce new, particular predictions. These predictions are tested by observation and experiment. The test results may be used in a new inductive step to obtain a better general theory. Using only deduction, people could not arrive at new theories. Using only induction, people could not correct and improve theories. By combining these methods, science is able to progress. Morton L. Schagrin

See also **Philosophy** (Logic).

Inductor. See **Electronics** (Passive components).

Indulgence, *ihn DUHL juhns,* is a term used in the Roman Catholic Church. It signifies a freeing from all or part of the *temporal* (earthly) punishment still due for sin after the guilt has been forgiven. The consequences and weaknesses of sin remain with the person. The church pledges that it will prayerfully intercede for the rehabilitation of the sinner. But the person must be penitent and perform works of devotion and charity, such as fasting, almsgiving, and making pilgrimages. Abuses surrounding the manner of preaching indulgences were a significant cause of the Protestant Reformation in the early 1500's. Richard L. Schebera

See also **Luther, Martin** (The Ninety-Five Theses); **Reformation** (picture: The sale of indulgences); **Roman Catholic Church** (The Reformation); **Tetzel, Johann.**

Indus River is the longest river in Pakistan. It is the source of one of the largest irrigation systems in the world. The Indus rises in Tibet north of the Himalaya, at an elevation of about 17,000 feet (5,180 meters). It travels west and southwest for 1,800 miles (2,897 kilometers) and empties into the Arabian Sea through several mouths. The river drains an area of about 375,000 square miles (970,000 square kilometers).

The Indian Peninsula has a larger system of modern irrigation canals than any comparable region in the world. Many of these canals are in the Indus Valley. The

partition (division) of India in 1947 gave most of the water in the Indus Basin to Pakistan. Dams along the Indus River supply water for the surrounding area. They include Tarbela Dam, one of the world's largest dams in volume.

The river became less important as a trade route when the Indus Valley Railway was built along it in 1878. Today, so much water is removed for irrigation that only small boats can use the river. H. J. McPherson

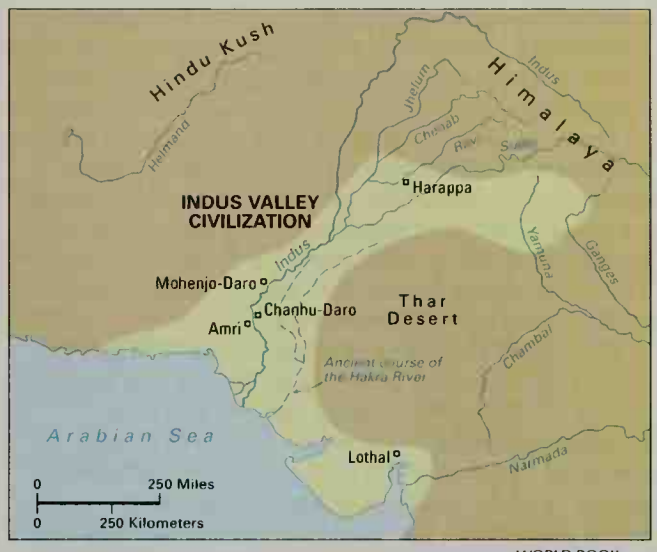
See also **Pakistan** (physical map); **Punjab.**

Indus Valley civilization was one of the world's first great civilizations. It began to flourish about 4,500 years ago and was centered in the vast river plains of what are now Pakistan and northwestern India. This civilization is sometimes called the *Harappan civilization.* It is named after the Pakistani town of Harappa, where archaeologists first discovered evidence of the culture.

Development of the Indus civilization. The Indus civilization developed out of farming and herding communities that carried on trade with each other. About 2500 B.C., the communities became more unified culturally, and in some places people began laying out carefully planned cities. In time, the Indus civilization grew to cover most of present-day Pakistan and parts of what are now Afghanistan and northern India. The heart of the civilization was the vast flood plain of the Indus and Hakra rivers. The Hakra River (also known as the Ghaggar River or Sarasvati River) is now dried up. It once flowed east of—and parallel to—the Indus River, in what are now India and Pakistan. The civilization developed a standardized system of weights and measures and a system of writing that used pictographs (simple drawings representing words).

In the early 1800's, British scholars learned that people had found ancient artifacts buried in huge earthen mounds in the region. But it was not until the 1920's that archaeologists began excavating these sites and realized that they contained the remains of cities from a previously unknown civilization. Hundreds of Indus sites have been found.

Indus culture. The Indus people planned their cities carefully. They built many of their buildings on mud-brick platforms that protected the buildings from seasonal floods. Houses were made of baked or sun-dried brick. Many houses had two stories. Most homes had a bathing area that was supplied with water from a nearby public well or from a well in the courtyard of the house. In larger communities, each house was connected to an elaborate city-wide drainage system. Other structures include large buildings that may have been used for storing grain and for other purposes.



WORLD BOOK map

The Indus Valley civilization was centered in the river plains of what is now Pakistan and northwestern India.

The Indus people traded extensively with one another. City people traded with nearby agricultural communities and with distant mining and other areas. Goods traded probably included cotton, lumber, grain, and livestock. For transport, people used pack animals, river boats, and ox carts. The Indus people also traded with other civilizations, including cultures in central Asia and Mesopotamia and along the Persian Gulf.

Indus artisans produced a variety of useful and decorative objects. They used copper and bronze to make tools, mirrors, pots, and pans. Bone, shell, and ivory were used to create ornaments, tools, game pieces, and inlay for furniture. Indus artisans also crafted silver and gold utensils and ornaments, as well as ornaments

Ruins of the Indus Valley civilization have been uncovered at Mohenjo-Daro, Pakistan. In the ruins, archaeologists have found many stone seals carved with the figures of animals, *left.* The large, brick-lined depression at the right may have served as a public or ritual bathing area.

Karachi Museum, Pakistan (Art Resource)

U.C. Berkeley Expedition to Harappa and the Govt. of Pakistan Department of Archaeology and Museums (J. M. Kenoyer)

made of stoneware and earthenware. Indus sculptors made clay figurines of animals and people, probably for use in religious rituals. They also made small limestone figures that may represent gods or important people.

The most unusual objects found at Indus sites include square stone seals engraved with pictographs and drawings of animals. Pictographs have also been found on Indus pottery and other objects. However, scholars have been unable to decipher what the writings mean. The Indus people buried their dead, often in wooden coffins along with pottery vessels.

Decline of the Indus civilization. By 1700 B.C., the Indus civilization had gradually broken up into smaller cultures, called *late Harappan cultures* and *post-Harappan cultures*. The breakup was partly caused by changing river patterns. These changes included the drying up of the Hakra River and changes in the course of the Indus River. The river changes disrupted agricultural and economic systems, and many people left the cities of the Indus Valley region. However, some aspects of Indus art, agriculture, and possibly social organization continued in the smaller cultures. Some of these aspects became incorporated into a unified urban civilization that began developing throughout the region about 600 B.C. Jonathan Mark Kenoyer

See also **Sculpture** (Beginnings); **World, History of the** (Early centers of civilization [The Indus Valley]).

Industrial arts is an area of general education that deals with technology and industry. The field is also known as *technology education*. It provides opportunities for students to study, observe, experiment, and work with industrial tools, machines, materials, and processes. Industrial arts programs are offered in elementary school and high school and by colleges and universities. The programs include courses in automobile mechanics, electronics, graphic arts, industrial crafts, industrial drawing, metalworking, photography, plastics, and woodworking.

Education in the industrial arts began in the United States during the late 1800's. Since then, more and more students have enrolled in industrial arts programs. Today, about 7 million students are involved in such programs. In addition, many changes have taken place in industrial arts programs through the years to reflect technological developments.

In the past, most schools required boys to take industrial arts and girls to take home economics. Few girls studied industrial arts until the 1970's. Today, most courses in the field are coeducational.

School programs

Industrial arts courses become increasingly difficult through the school years as the manual skills and mental abilities of students develop. But the six basic goals of industrial arts programs remain the same: (1) to develop an understanding and appreciation of industry; (2) to teach students the use of industrial tools and machines; (3) to help students learn to work alone and in groups; (4) to encourage creativity; (5) to teach the use of industrial materials and their characteristics; and (6) to help students apply their knowledge and skills in industrial arts to other activities.

In elementary school, teachers combine industrial arts instruction with various classroom activities. Students work on projects based on units in science, social studies, and other subjects. They learn to plan projects, to use simple tools, and to work in groups. Students work with such materials as beads, clay, plastics, soft metals, textiles, and wood.

In junior high school, students in industrial arts programs work with many types of equipment and materials. They study drafting, electronics, metalworking, plastics, printing methods, woodworking, and other technical processes. Each industrial arts class lasts only part of a school year in most junior high schools. A student might take metalworking for the first three months, woodworking the next three months, and drafting for the rest of the school year. Students work on both individual and group projects.

In high school, students who have had industrial arts courses in junior high may specialize in one or more areas. Those with no background in industrial arts take general courses. Students in advanced classes work with complex equipment, such as high-speed printing presses, machine lathes, and sensitive testing tools. They conduct research and experiments individually and in groups. Course work may include field trips. Instructors provide job information and may help students find employment in industry.

In colleges and universities. About 200 colleges and universities in the United States offer a bachelor's degree in industrial arts. Some of these schools also have master's degree and doctor's degree programs in the field. Men and women who plan to teach industrial arts must take certain education courses as well as technical courses. Classes include advanced instruction in industrial processes and practices. Students also learn to operate and maintain industrial equipment. Most courses require much research and experimentation.

Industrial arts courses

Industrial arts courses may concentrate on one kind of work, or they may teach several skills in less depth. The most specialized kind of course is the *unit shop* course, which deals with one way of processing one kind of material. In a machine shop course, for example, students learn to process metals with industrial machines, such as lathes and drills. In a *single field laboratory* course, students deal with only one kind of material, but they study several ways of working with it. For example, in a general metals course, students may learn to process metals by machining, gas and arc welding, *casting* (shaping melted metal), and *forging* (working metal by hammering and machine stamping). They also learn sheet-metal work. In a *multifield laboratory* or *comprehensive* course, students learn to process more than one kind of material. Such a course might include work with metals, plastics, and woods. In all industrial arts classes, instructors stress the proper use and maintenance of equipment.

Automobile mechanics courses emphasize the study of gasoline engines, especially those of cars. Students work on their own cars, on school laboratory models, or on motors of lawn mowers, tractors, or other machinery. They study various parts of automobiles, including the cooling system, drive train, fuel system, suspension components, and wheels and tires. Many courses teach students to make repairs.

Electronics courses teach the laws of electricity and how to apply this knowledge to actual situations. Students learn about circuits, electric parts, and wiring diagrams for radios, television sets, and other electric equipment. They also study the use of electronics in manufacturing and the numerical control of processing equipment. Class projects include construction of various communications devices, such as radios and telephones. Students work with hand tools, meters, and other electronics equipment.

Graphic arts include bookbinding, etching, linoleum-block cutting, photography, and printing. Students learn to set type and to use binding machines, cameras, paper drills, line gauges, plates and presses, and other printing equipment. They also learn to select colors, designs, and paper for printed materials. In addition, they study various printing processes.

Industrial crafts courses offer an opportunity for creativity and self-expression. Students design and make many items, using various materials and techniques. The materials include clay, leather, metals, and precious stones. Students also study the chemical and physical characteristics of many materials and how these materials are used in industry.

Industrial drawing courses teach students how to prepare blueprints and sketches used in designing and building equipment and other items. Students make drawings that show an object from several angles to indicate its exact shape and size. They learn such skills as correct dimensioning, proper view arrangement, and scale drawing. Equipment used in industrial drawing courses includes compasses, drafting instruments, pencils and pens, scales, triangles, and T squares.

Industrial drawing courses also introduce students to advanced drafting techniques, copy making, and tracing procedures. Architectural drawing is also taught as a part of the drawing program in many schools.

Metalworking. In this course, students work with a variety of metals and learn many methods of metal processing. They study art metalwork, heat-treating methods, hot metal casting, sheet-metal work, simple forging operations, and welding. Some of the classes also study the chemical and physical characteristics of metals. Students learn to use drill presses, lathes, precision gauges, scales, and other equipment. Metalworking classes may include field trips to steel mills and other industrial plants.

Photography courses teach students various techniques of taking and developing pictures. Students learn to use light meters, photo enlargers, processing equipment, and several types of cameras. They investigate lighting and exposure procedures for specialty shots. Classes also include technical instruction about filters, lenses, and photographic films. Some schools include photography in their graphic arts courses.

Plastics courses teach students how plastics materials are processed into commercial and industrial products. Classes study such industrial processes as *injection molding* (squeezing resins into a mold), *blow molding* (inflating melted resins inside a mold), casting, and *extrusion* (squeezing resins through a heating chamber).

In addition, they study *polymer chemistry* (the molecular structure of plastics) and plastics identification. They also study and test various plastics for such properties as strength, flowability, flexibility, and toughness. Other skills taught include cementing and welding, designing, making molds, and decorating. Classes often visit industrial plastics plants to study processes not available in school.

Woodworking courses teach students how to make many useful items out of wood. Projects vary in size and difficulty from bookshelves to stereo cabinets. Students use hand tools, such as chisels and hammers, and power tools, including jigsaws and wood-turning lathes. Some classes work in groups to learn mass-production techniques used by the woodworking industry. Other woodworking skills taught include finishing techniques, upholstery work, wood patternmaking for metal castings, and wood turning. Some woodworking courses teach carpentry skills.

History

Beginnings. Industrial arts education was called *manual training* when it was introduced in the United States in the late 1800's. In 1876, Calvin M. Woodward, an educator at Washington University in St. Louis, attended the Philadelphia Centennial Exposition. An exhibit of woodworking projects from a Russian technical school impressed Woodward, and in 1880, he opened the Manual Training School in St. Louis. This school was the first of its kind in the country.

In 1884, Baltimore became the first U.S. city to include manual training in its public school program. By 1893, about 50 public school systems offered manual training courses. The earliest programs consisted mainly of mechanical drawing and woodworking courses and aimed at teaching students how to use a variety of hand tools. During the 1890's, the design and production of artistic objects became the major goal of the programs. Educators began to substitute the term *manual arts* for manual training.

The early 1900's brought further changes to manual arts programs. Instructors began placing less emphasis on arts and crafts and more importance on the study of industrial problems and techniques. As a result, many educators started using the term *industrial arts* instead of manual arts.

Great technological developments following the end of World War II in 1945 led to further changes in industrial arts education. Schools added courses in communication and transportation, and students of industrial arts began to use many more power tools in class.

Recent trends. An important trend in industrial arts is a new emphasis on ideas rather than skills. Educators have developed courses to help students understand industry and its effect on society. The courses cover all phases of industrial operation, including communications, energy sources, finance, marketing, materials, processing, research, and transportation. As part of their work, students may set up a model business and manufacturing operation, talk with people employed in industry, and apply industrial techniques to school situations. Problem solving and resourcefulness are emphasized. The United States government and private agencies financed several of these programs.

Many industrial arts programs are adding the study of high technology. Students learn about such developments as computer-aided design and manufacturing,

lasers, numerically controlled manufacturing machinery, and robotics.

Industrial arts played an important role in the *career education* movement of the 1970's and 1980's. Career education helps students choose and prepare for a career. Industrial arts courses enable them to work with many tools and materials and to study various industries and occupations. Students learn about their own abilities and about possible types of work. As a result, they can make wiser career decisions.

Industrial arts has also contributed to the consumer education movement, which works to make the buying public better informed. Industrial arts teachers use learning experiences to help students select, use, and care for industrial products.

Another trend involves greater opportunities for girls, women, and individuals with handicaps. During the 1970's, many automotive, metalworking, and other industrial arts courses became coeducational for the first time. Educators also developed special equipment and teaching methods for students with physical or mental disabilities. Ronald J. Baird

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Industrial design is the process of planning and developing products and systems. Industrial designers create products to perform specific functions. The products must be attractive as well as safe, reliable, and easy to maintain. They must also be easy and inexpensive to manufacture. Industrial designers must combine artistic ability with a knowledge of engineering, costs, materials, manufacturing processes, and marketing conditions. They have a great impact on deciding what products are available to consumers.

© Chuck O'Rear, West Light

An industrial designer may work with scale models to refine a design before building a full-sized prototype of a new car.

Products of industrial design. Some industrial designers work on products for everyday home and office use. Such products include cars, cameras, computers, lighting fixtures, office furniture, television sets, and tools. Other designers develop such specialized products as antipollution devices, medical equipment, and spacecraft. Still others work on special projects, such as packaging, product trademarks, trade show exhibits, and interior layouts of buildings.

How an industrial designer works. Some industrial designers work for one company and may specialize in just a few products. Others own or work for consulting firms that handle many kinds of projects. Consultants are usually hired for a specific project. They often receive a royalty in addition to a design fee. Consultants might serve as the design group for the client or simply provide extra talent and experience to help the client's own design group. A large consulting firm may have several hundred employees, including architects, artists, engineers, marketing experts, and technicians.

Designers do considerable research on their products. They carefully study related technologies and reports and examples of similar and competing products. They also survey consumer preferences. The designers then create a number of designs for their products. These preliminary designs are discussed with managers, engineers, and marketing experts. After company officials approve a design, designers may prepare models of the products using clay, plastic, or wood. Or they may create electronic "models" on computers using CAD (*c*omputer-*a*ided *d*esign) programs. Later, *prototypes,* or testing models, are constructed with the actual materials to be used on the products. Many design firms produce prototypes from electronic models by using a system known as CNC (*c*omputer *n*umerical *c*ontrol) to precisely operate machine tools.

History. The term *designer* was first used in the late 1600's when division of labor increased. Prior to that time, a craftworker would design a product while making it. During the mid-1800's, manufacturers began to produce electrical appliances and other machines for home use. In those days, people bought machines for the work they could do and were not greatly concerned about how the machines looked.

By the early 1900's, the public had choices when buying radios, toasters, and similar devices. When two radios worked the same, customers chose the more attractive one. Manufacturers realized the need for good design to maintain sales. The profession of industrial design developed to fill this need.

Careers in industrial design. Most people who desire careers in industrial design take a special program of study at an art school, technical college, or university. Design students may take such courses as basic computer skills, basic engineering, clay and wood modeling, CAD, mechanical drawing, perspective rendering, and product design. A knowledge of applied psychology is also helpful. Tin-Man Lau

See also Design; Packaging.

Industrial legislation. See Labor movement.

Industrial pollution. See Environmental pollution; Water pollution.

Industrial psychology is concerned with people at work. It is also called *personnel psychology.* A closely

related field is known as *organizational psychology.* Traditionally, industrial psychologists have assessed differences among individual workers and have evaluated individual jobs. Organizational psychologists generally seek to understand how workers function in an organization, and how the organization functions in society.

The distinctions between industrial psychology and organizational psychology are not always clear. Thus, the two areas are often referred to jointly as *industrial/organizational psychology,* or *I/O psychology.* I/O psychologists work for businesses, consulting firms, government agencies, and colleges and universities.

Both industrial and organizational psychologists help determine fair pay scales, generally based on the levels of skill and education a job requires and any hazards it poses. I/O psychologists also research causes of and ways of reducing on-the-job accidents.

Industrial psychologists typically help employers find the best person for a job, evaluate job performance, and train employees. In developing a system for matching an individual to a job, an industrial psychologist must first determine what special knowledge, skills, and abilities the job demands. The psychologist then designs a selection system to judge an applicant's qualifications for the job. The objective of such a system is to predict a person's performance on the job. Commonly used selection tools include interviews, letters of reference, work samples, and tests of aptitudes, abilities, knowledge, interests, and personality.

Developing methods of evaluating job performance is a major function of an industrial psychologist. Psychologists often create a numerical scale to use in rating an employee's performance. To have value, a system should maximize the accuracy with which people rate performance, and minimize bias.

Industrial psychologists commonly develop training programs. This function involves identifying performance or technical needs of employees that can be met by training. It also deals with evaluating the effectiveness of the training program. Training needs may include ways to (1) help new employees get used to the organization, (2) update technical skills of current employees, and (3) prepare employees for new responsibilities. Techniques used in training include classroom lectures, work simulators, computer-assisted instruction, and role playing.

Organizational psychologists devote much time to job satisfaction. They investigate factors that have been found to relate to satisfaction, including employee turnover, absenteeism, age, pay, and attitudes toward unions. Organizational psychologists also study motivation because evidence suggests that both motivation and ability are necessary for employees to succeed in their jobs. Thus, psychologists develop systems for rewarding good performance, and they redesign jobs for greater interest and challenge.

Another important concern of organizational psychologists is what makes an effective leader. The psychologists help identify the personality traits of a good leader and the types of leaders who should be selected for a particular position.

Organizational psychologists also help maximize efficiency by redesigning the lines of authority or communication in an organization. Organizational psychologists may also work to improve an organization's efficiency by addressing such physical factors as its work schedules, layout, design of its tools and equipment, and levels of heat, light, and noise. Gerald V. Barrett

See also **Personnel management; Testing.**

Industrial relations involves dealings between employees and their employers. Effective relations between labor and management are important in an industrial society. Relations between labor unions and management are the chief factors in industrial relations. But the term also refers to other human relations, including relations between individual workers and relations between workers and their immediate supervisors.

The industrial relations system establishes the rules that govern the employer-employee relationship. It helps to determine wages and salaries, hours of work, working conditions, hiring and training procedures, recreation facilities, and insurance programs.

Collective bargaining. Employees in many industries have chosen labor unions to represent them in negotiations with their employers. Nearly a fifth of U.S. workers are covered by *collective bargaining agreements* between unions and management. The proportion of workers covered is highest among government employees. It is also high in the manufacturing, transportation, mining, and construction industries.

A collective bargaining agreement establishes many of a company's industrial relations procedures. Collective bargaining agreements also affect workers in non-union facilities, because they often set a pattern followed by other companies.

In their early years, American unions often had difficulty in getting management to recognize them as bargaining representatives for workers. After passage of the National Labor Relations Act (Wagner Act) in 1935, unions were more widely accepted. The act established the National Labor Relations Board and required employers to accept a union as a bargaining representative if chosen by employees. The Labor-Management Relations Act (Taft-Hartley Act) of 1947 changed this process slightly. But most legal procedures established in the 1935 act are still essentially the same today. The Taft-Hartley Act outlawed the practice of hiring only union members. However, many states permit the practice of requiring workers to join the union after being hired. See **Taft-Hartley Act.**

The settlement of disputes. A *grievance procedure* is now part of most collective bargaining agreements. This procedure provides an orderly series of steps which can be used to settle disputes concerning agreements. If the disputes cannot be settled through talks between labor and management, the matter is sent to an *arbitrator* (an expert with power to decide). Both sides must accept the arbitrator's decision.

When bargaining fails, workers sometimes strike to try to force management to meet their demands. But they have used strikes less in recent years because of the orderly procedures set up through collective bargaining agreements and legislation. Daniel Quinn Mills

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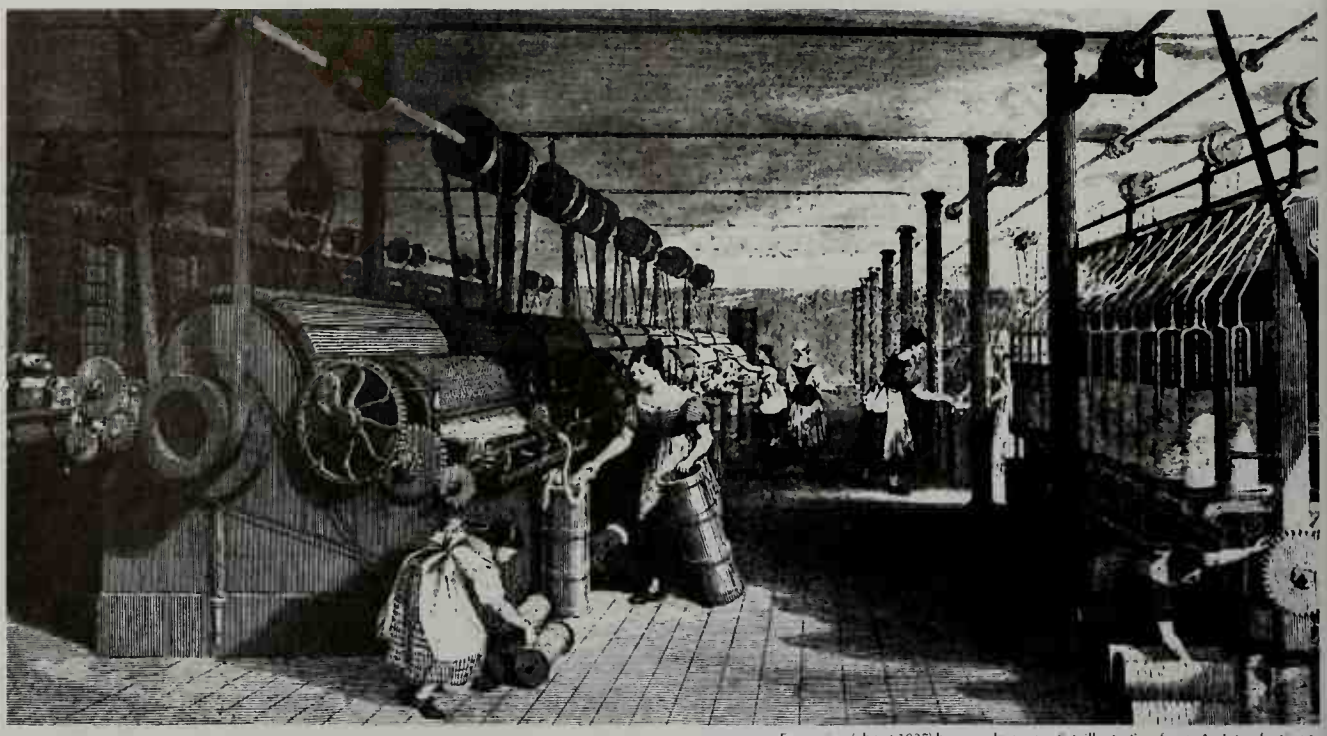

Engraving (about 1835) by an unknown artist; illustration from *An Introduction to the Industrial and Social History of England*, courtesy Newberry Library, Chicago

Factories developed during the Industrial Revolution to bring together the machines and the workers to run them. Women and children operated many machines in textile factories, *shown here.*

Industrial Revolution

Industrial Revolution. During the late 1700's and early 1800's, great changes took place in the lives and work of people in several parts of the Western world. These changes resulted from the development of industrialization. The term *Industrial Revolution* refers both to the changes that occurred and to the period itself.

The Industrial Revolution began in Britain (a country now known as the United Kingdom) during the late 1700's. It started spreading to other parts of Europe and to North America in the early 1800's. By the mid-1800's, industrialization was widespread in western Europe and the northeastern United States.

The introduction of power-driven machinery and the development of factory organization during the Industrial Revolution created an enormous increase in the production of goods. Before the revolution, manufacturing was done by hand, or by using animal power or simple machines. Most people worked at home in rural areas. A few worked in shops in towns and belonged to associations known as *guilds.* The Industrial Revolution eventually took manufacturing out of the home and workshop. Power-driven machines replaced handwork, and factories developed as the most economical way of bringing together the machines and the workers to operate them.

As the Industrial Revolution grew, private investors and financial institutions provided money for the further expansion of industrialization. Financiers and banks thus became as important as industrialists and factories in the growth of the revolution. For the first time in European history, wealthy business leaders called *capitalists* took over the control and organization of manufacturing.

Historians have disagreed about the overall effect of the Industrial Revolution on people's lives. Some historians have emphasized that the revolution greatly increased the production of goods. They argue that this increase did more to raise people's standard of living after 1850 than all the actions of legislatures and trade unions. Other historians have stressed the negative effects of the revolution. They point to the overcrowded and unsanitary housing and the poor working conditions created by rapid industrialization in the cities. Most historians now believe that factory conditions and worker wages were terrible before 1850 but improved after that date. These improvements led to an increase in life expectancy for workers.

Most historians agree that the Industrial Revolution was a great turning point in the history of the world. It changed the Western world from a basically rural and agricultural society to a basically urban and industrial society. Industrialization brought many material benefits, but it also created a large number of problems that remain critical in the modern world. For example, most industrial countries face problems of air, land, and water pollution.

Life before the Industrial Revolution

On the eve of the Industrial Revolution, less than 10 percent of the people of Europe lived in cities. The rest lived in small towns and villages scattered across the

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countryside. These people spent most of their working day farming. Unless they could sell surplus food in nearby towns, they grew little more than they needed for themselves. The people in rural areas made most of their own clothing, furniture, and tools from raw materials produced on the farms or in forests.

Before the Industrial Revolution, some industry existed throughout western Europe. A little manufacturing took place in guild shops in towns. Craftworkers in the shops worked with simple tools to make such products as cloth, hardware, jewelry, leather goods, silverware, and weapons. Some products made in the towns were exchanged for food raised in the countryside. Town products were also exported to pay for luxuries imported from abroad, or they were sent to the colonies in payment for raw materials.

Most manufacturing, however, took place in homes in rural areas. Merchants called *entrepreneurs* distributed raw materials to workers in their homes and collected the finished products. In most places, the entrepreneurs owned the raw materials, paid for the work, and took the risk of finding a market for their products. They often spread their operations to nearby villages. In the home, the whole family worked together making clothing, food products, textiles, and wood products. Workers themselves provided most of the power for manufacturing. Water wheels furnished some power.

The way of life differed from place to place, depending on the climate, the soil, and the distance from towns and trade routes. For most people, life revolved around the agricultural seasons—planting, cultivating, harvesting, and processing the harvest. The way of life changed little from one generation to the next, and most sons followed their father's trade.

Life was hard for most people. They lived under the constant threat that their crops might fail. Although few people starved, many of them suffered from malnutrition. As a result, they caught diseases readily, and epidemics were common. Most workers produced little and earned little. Only a few people enjoyed large incomes, usually because they owned inherited land, held public office, or had succeeded in business. Little money was saved or invested in business ventures. Outside of cities, there were few opportunities for investment.

Before the Industrial Revolution, powerful monarchs ruled most European countries. Great landowners, rich merchants, and some members of the clergy also had considerable political influence. But the workers and farmers had no voice in the government. Many countries did not even hold elections. Although Britain had a Parliament, only men who paid a certain amount of taxes could vote. A handful of voters often determined who would represent a district in Britain. All these social, economic, and political conditions changed in Britain as the Industrial Revolution developed.

Growth of the Industrial Revolution

The Industrial Revolution began in Britain for several

Engraving (1791) by William Hincks; Granger Collection

The domestic system produced most manufactured goods before the Industrial Revolution. Under this system, an entire family worked at home to make cloth, *shown here,* and other products.

reasons. The country had large deposits of coal and iron, the two natural resources on which early industrialization largely depended. Other industrial raw materials came from the various colonies of Britain. By the late 1700's, the country had become the world's leading colonial power. British colonies provided raw materials as well as markets for manufactured products. These colonial markets helped stimulate the textile and iron industries, which were probably the two most important industries during the Industrial Revolution.

In addition, Britain's scientific culture emphasized practical application and invention. For example, this culture helped make it possible for James Watt, a Scottish engineer, to make great improvements in the operation of the steam engine.

The demand for British goods grew rapidly during the late 1700's both at home and abroad. This demand forced businesses to compete with one another for the limited supply of labor and raw materials, which raised production costs. The rising costs of production began to cut into profits. Further demand could not be satisfied until Britain enlarged its capacity to produce goods inexpensively.

British merchants did not want to raise the prices of their goods and thus discourage demand. They sought more economical and efficient ways of using capital and labor so the amount each worker produced would increase faster than the cost of production. The merchants achieved their goal through the development of factories, machines, and technical skills.

The textile industry. One of the most spectacular features of the Industrial Revolution was the introduction of power-driven machinery in the textile industries of England and Scotland. This introduction took place between 1780 and 1810 and marked the beginning of the age of the modern factory.

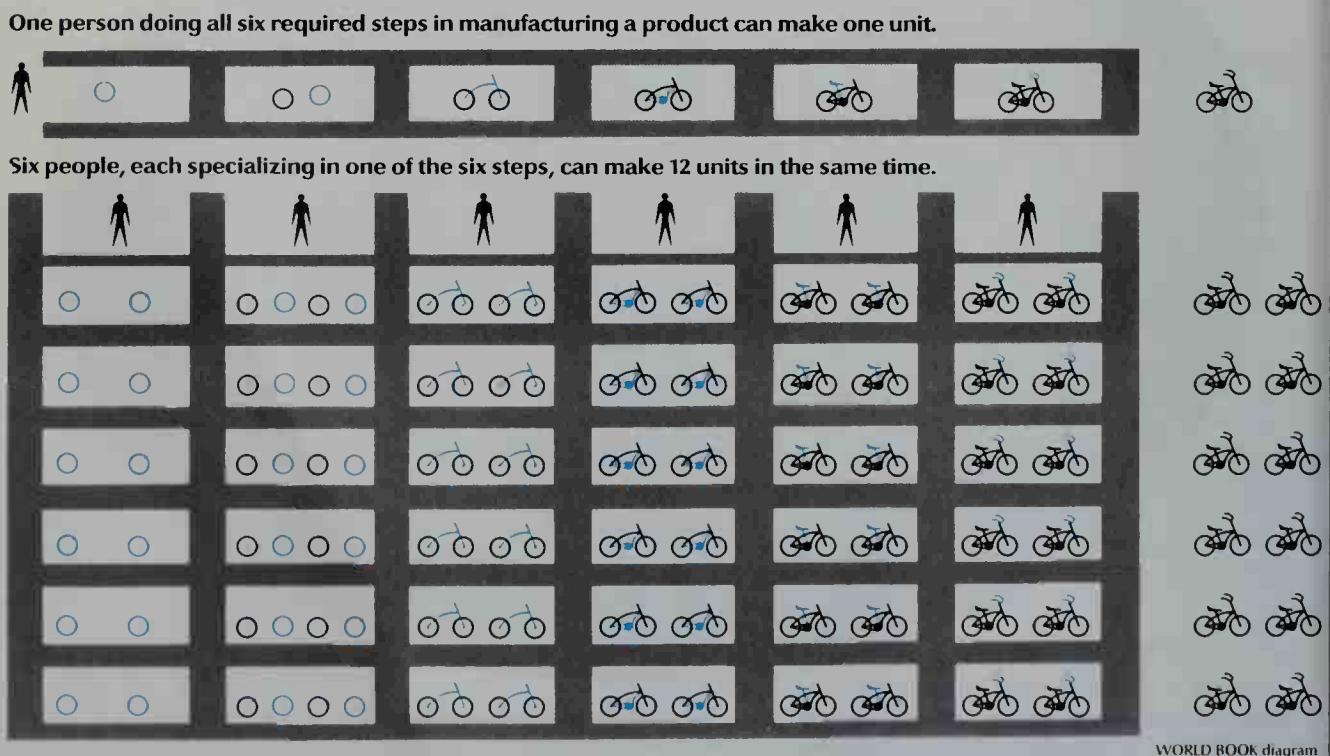
Before the industrialization of the textile industry, merchants purchased raw materials and distributed them among workers who lived in cottages on farms or in villages. Some of these workers spun the plant and animal fibers into yarn, and others wove the yarn into cloth. This system was called *domestic* or *cottage* industry.

Under the domestic system, merchants bought as much material and employed as many workers as they needed. The merchants financed the entire operation. Some of them owned the spinning and weaving equipment and the workers' cottages. However, the workers had much independence and set their own pace of work. They often accepted work from several merchants at the same time.

The domestic system presented many problems for the merchants. They had difficulty regulating standards of workmanship and maintaining schedules for completing work. Workers sometimes sold some of the yarn or cloth for their own profit. As the demand for cloth increased, merchants often had to compete with one another for the limited number of workers available in a manufacturing district. All these problems raised the merchants' costs. As a result, the merchants turned increasingly to machinery for greater production and to factories for central control over their workers.

Spinning machines. For hundreds of years before the Industrial Revolution, spinning had been done in the

Division of labor The division of labor, a basic feature of industrialization, developed during the Industrial Revolution. Division of labor requires that different workers do each step in manufacturing a product. This diagram shows how dividing the work greatly increases production for larger markets.



WORLD BOOK diagram

home on a simple device called a *spinning wheel.* One person operated the wheel, powering it with a foot pedal. The wheel produced only one thread at a time.

The first spinning machines were crude devices that often broke the fragile threads. In 1738, Lewis Paul, an inventor from Middlesex (now part of London), and John Wyatt, a Lichfield mechanic, patented an improved *roller-spinning machine.* This machine pulled the strands of material through sets of wooden rollers that moved at different speeds, making some strands tighter than others. When combined, these strands were stronger than strands of uniform tightness. The combined strands passed onto the *flier,* the part of the machine that twisted the strands into yarn. The finished yarn was wound onto a bobbin that revolved on a spindle. Mechanically, the roller-spinning machine was not completely successful. However, it was the first step in the industrialization of textile manufacturing.

In the 1760's, two new machines revolutionized the textile industry. One was the *spinning jenny,* invented by James Hargreaves, a Blackburn weaver and carpenter. The other machine was the *water frame,* or *throstle,* invented by Sir Richard Arkwright, a former Preston barber. Both machines solved many of the problems of roller spinning, especially in the production of yarn used to make coarse cloth.

Between 1774 and 1779, a Lancashire weaver named Samuel Crompton developed the *spinning mule.* This machine combined features of the spinning jenny and the water frame and, in time, replaced both machines. The mule was particularly efficient in spinning fine yarn for high-quality cloth, which, before the invention of the mule, had been imported from India. During the 1780's and 1790's, larger spinning mules were built. They had metal rollers and several hundred spindles. These machines ended the home spinning industry. For further information on the development of spinning machines, see **Spinning.**

The first textile mills appeared in Britain in the 1740's. By the 1780's, England had 120 mills, and several had been built in Scotland.

Weaving machines. Until the early 1800's, almost all weaving was done on handlooms because no one could solve the problems of mechanical weaving. In 1733, John Kay, an English engineer, invented the *fly shuttle* (also called flying shuttle). This machine made all the movements for weaving. However, it often went out of control.

In the mid-1780's, an Anglican clergyman named Edmund Cartwright developed a steam-powered loom. In 1803, John Horrocks, a Lancashire machine manufacturer, built an all-metal loom. Other British machine makers further improved the steam-powered loom during the early 1800's. By 1835, Britain had more than 120,000 power looms. Most of them were used to weave cotton. After the mid-1800's, handlooms were used only to make fancy-patterned cloth, which still could not be made on power looms. See **Weaving.**

The steam engine. Many of the most important inventions of the Industrial Revolution required much more power than horses or water wheels could provide. Industry needed a new, cheap, and efficient source of power and found it in the steam engine.

The first commercial steam engine was produced in 1698. That year, Thomas Savery, a Cornish army officer, patented a pumping engine that used steam. In 1712, Thomas Newcomen, a Devonshire tool seller, created an improved engine. Newcomen's engine came into general use during the 1720's.

Newcomen's steam engine had serious faults. It wasted much heat and used a large amount of fuel. In the 1760's, a Scottish engineer named James Watt began working to improve the steam engine. By 1785, he had eliminated many of the problems of earlier engines. Watt's engine used heat much more efficiently than Newcomen's engine and used less fuel. For more information on the development of the steam engine, see **Steam engine** (History).

The enormous potential of the steam engine and power-driven machinery could not have been achieved without the development of machine tools to shape metal. When Watt began working with the steam engine, he could not find a tool that drilled a perfectly round hole. As a result, his engines leaked steam. In 1775, John Wilkinson, a Staffordshire ironmaker, invented a *boring* machine that drilled a more precise hole. Between 1800 and 1825, English inventors developed a *planer,* which smoothed the surfaces of the steam engine's metal parts. By 1830, nearly all the basic machine tools necessary for modern industry were in general use.

Coal and iron. The Industrial Revolution could not have developed without coal and iron. Coal provided the power to drive the steam engines and was needed to make iron. Iron was used to improve machines and tools and to build bridges and ships. Britain's large deposits of coal and iron ore helped make it the world's first industrial nation.

Early ironmaking. To make iron, the metal must be separated from the nonmetallic elements in the ore. This separation process is called *smelting* (see **Smelting**). For thousands of years before the Industrial Revolution, smelting had been done by placing iron ore in a furnace with a burning fuel that lacked enough oxygen to burn completely. Oxygen in the ore combined with the fuel, and the pure, melted metal flowed into small molds called *pigs.* The pigs were then hammered by hand into sheets. Beginning in the early 1600's, the pigs were shipped to *rolling mills.* At a rolling mill, the pig iron was softened by reheating and rolled into sheets by heavy iron cylinders.

The most practical fuel for smelting was charcoal, which was made by burning hardwoods. Most of Britain's iron ore deposits and hardwood forests were located in rural areas. Smelting and rolling thus became rural activities done by local workers. Since the 1600's, charcoal had been used in many other manufacturing processes besides smelting and rolling. Wood was also in demand for other purposes. As a result, Britain had almost used up its hardwood forests by the early 1700's. Charcoal became so expensive that many ironmakers in Britain quit the industry because of the high costs of production.

The revolution in ironmaking. Between 1709 and 1713, Abraham Darby, a Shropshire ironmaker, succeeded in using *coke* to smelt iron. Coke is made by heating coal in an airtight oven. Smelting with coke was much more economical and efficient than smelting with char-

coal. But most ironmakers continued to use charcoal. Manufacturers complained that coke-smelted iron was brittle and could not be worked easily. They still preferred the more workable iron smelted with charcoal. About 1750, Darby's son Abraham Darby II developed a process that made coke iron as easy to work as charcoal iron. After 1760, coke smelting spread throughout Britain.

In the 1720's, an important breakthrough occurred in rolling the iron. Grooves were added to the rolling cylinders, allowing manufacturers to roll iron into different shapes, instead of simply into thin sheets.

A Fareham ironmaker named Henry Cort took out a patent for improved grooved rollers in 1783. The next year, he patented a *puddling furnace*. Cort did not invent the puddling furnace, but he made great improvements in it. The puddling process produced high-quality iron. Pig iron was reheated in Cort's puddling furnace until it became a paste. A person known as a *puddler* stirred the paste with iron rods until the impurities were burned away. The purified iron was then passed through Cort's grooved rollers and formed into the desired shape.

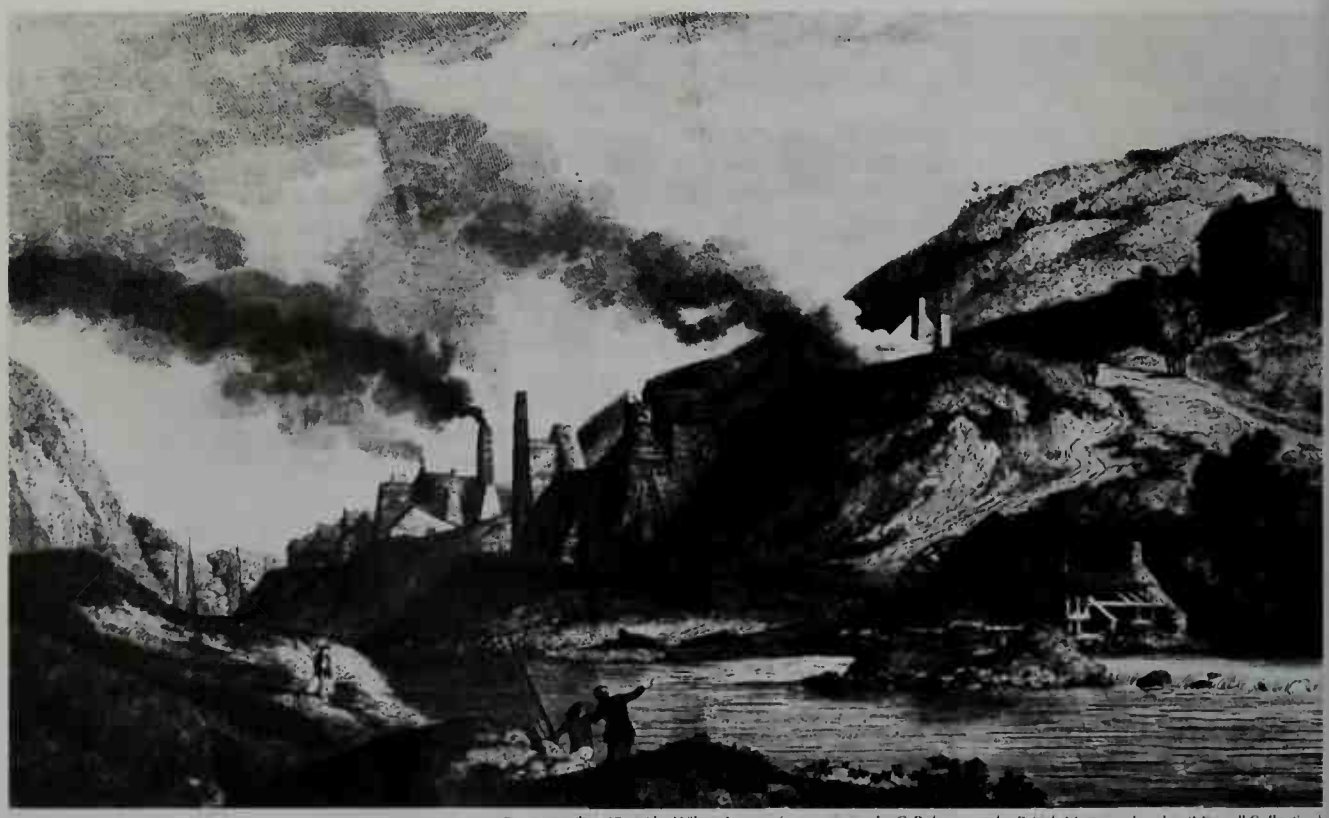
Before Cort developed his puddling furnace, ironmakers had to use charcoal to reheat the pig iron for rolling. But Cort's furnace—with its combined rolling mill—used coke. The use of coke for smelting and puddling finally freed the British iron industry of any dependence on charcoal. In addition, the smelting, puddling, and rolling steps could be combined into a continuous operation near the coal fields. As a result, the British iron industry became concentrated in four coal-mining regions—Staffordshire, Yorkshire, southern Wales, and along the River Clyde in Scotland.

Ironmaking techniques continued to improve, and iron production expanded enormously. In 1788, for example, British ironmakers produced about 76,000 tons (68,900 metric tons) of iron. In 1806, they produced more than three times that amount. During the mid-1700's, probably only about 5 percent of all British iron was made into machine parts. Most machines were made out of wood. By the early 1800's, however, manufacturers used iron to make numerous products, including machine frames, rails, steam engine parts, and water pipes.

Transportation. The growth of the Industrial Revolution depended on industry's ability to transport raw materials and finished goods over long distances. Thus, the story of the Industrial Revolution is also the story of a revolution in transportation.

Waterways. Britain had many rivers and harbors that could be adapted to carrying freight. Until the early 1800's, waterways provided the only cheap and effective means of hauling coal, iron, and other heavy freight.

British engineers widened and deepened many streams to make them navigable. They also built canals to link cities and to connect coal fields with rivers. In 1777, the Grand Trunk Canal connected the River Mersey with the Trent and Severn rivers and thus linked the English ports of Bristol, Hull, and Liverpool. British engineers also built many bridges and lighthouses and deepened harbors. Parliament had to approve many of



Engraving (late 1700s) by Wilson Lowry after a painting by G. Robertson; the British Museum, London (Mansell Collection)

Large ironworks made Britain the world's leading iron producer during the Industrial Revolution. The iron industry was concentrated near the country's coal and iron ore deposits.

these construction efforts because they often involved the take over of private land.

In 1807, the American inventor Robert Fulton built the first commercially successful steamboat. Within a few years, steamboats became common on British rivers. By the mid-1800's, steam-powered ships were beginning to carry raw materials and finished products across the Atlantic Ocean.

Roads. Until the mid-1700's, Britain had poor roads. Most usable roads extended only a short distance beyond a town. Horse-drawn wagons traveled with difficulty, and pack animals carried goods over long distances. People rarely traveled by stagecoach. They rode horseback or walked.

A series of turnpikes was built between 1751 and 1771. These roads made travel by horse-drawn wagons and stagecoaches easier. But by the late 1700's, the turnpikes needed repairs badly.

Two Scottish engineers, John Loudon McAdam and Thomas Telford, made important advances in road construction during the early 1800's. McAdam originated the *macadam* type of road surface, which consists of crushed rock packed into thin layers. Telford developed a technique of using large flat stones for road foundations. These new methods of roadbuilding made travel by land faster and smoother. As a result, manufactured goods could be delivered more efficiently. The orders and money involved in business and industry also moved faster and more simply.

Railroads. The first rail systems in Britain transported coal. Horses pulled the freight cars, which moved on iron rails. In 1804, a Cornish engineer, Richard Trevithick, built the first steam locomotive. Several other locomotives were built during the next 20 years, and they were used to haul freight at coal mines and at ironworks. However, industry generally preferred to use stationary engines that pulled the freight cars by means of cables. Steam locomotives did not begin to come into general use for passenger and freight transportation until the late 1830's. See **Railroad** (History); **Locomotive** (History).

The role of capital. Individual investors played a vital part in the growth of the Industrial Revolution from the beginning. During the 1700's, many British merchants made fortunes from European wars, from the slave trade with North America, or from commerce with British colonies. Consumer activity also increased within Britain at the same time. Merchants as well as others in Britain began seeking investment opportunities.

Gradually, banks were founded to handle the increased flow of money. In 1750, London had 20 banks. By 1800, the city had 70.

Most banks did not directly invest in factories or make loans to factory owners for the purchase of machinery. Some banks, however, made short-term loans to industrialists to cover their operating expenses. Such loans allowed industrialists to use their own money to purchase equipment and improve and expand their factories.

As machinery and factories became more expensive, the individuals who provided capital grew increasingly important. These *industrial capitalists* soon became one of the most powerful forces in British commercial and political life. Most capital came from merchants who lent it to people familiar with industrial tools, machines, and processes. In many cases, these people were friends or relatives of the merchants.

Life during the Industrial Revolution

The Industrial Revolution caused great changes in people's way of life. The first changes appeared locally. But by the early 1800's, most British people knew they were in the midst of a nationwide economic and social revolution. Educational and political privileges, which once had belonged largely to the upper class, spread to the growing middle class. Some workers were displaced by machines, but others found new jobs working with machinery. Both workers and employers had to adjust to a new cold and impersonal relationship. In addition, most workers lived and worked under harsh conditions in the expanding industrial cities.

The working class. Under the domestic system, many employers had a close relationship with their workers and felt some responsibility for them. But such relationships became impossible in the large factories of the Industrial Revolution. Industrialists employed many workers and could not deal with them personally. The working day probably was no longer under industrialism than under the domestic system—about 12 to 14 hours a day for six days a week. But in the factories, the machines forced workers to work faster and without rest. Jobs became more specialized, and the work became monotonous.

Factory wages were low. Some employers kept them low deliberately. Many people agreed with the English writer Arthur Young, who wrote: "Everyone but an idiot knows that the lower classes must be kept poor, or they will never be industrious." Women and children worked as unskilled laborers and made only a small fraction of men's low wages. Children—many of them less than 10 years old—worked from 10 to 14 hours a day. Some were deformed by their work or crippled by unsafe machines. See **Child labor.**

Most factory workers, like other types of workers, were desperately poor and could not read or write. Housing in the growing industrial cities could not keep up with the migration of workers from rural areas. Severe overcrowding resulted, and many people lived in extremely unsanitary conditions that led to outbreaks of disease. During the 1830's, for example, the life expectancy for men in Birmingham, England, was only slightly more than 40 years. See **City** (Industrial cities).

Until the early 1800's, British employers usually held the advantage in relations with their employees. Workers were not permitted to vote and could do little legally to improve their condition. British law forbade trade unions, and workers who joined a union could be imprisoned.

However, some workers did form trade unions. Many workers also went on strike or rioted. In the riots, unemployed workers destroyed machinery in an attempt to gain revenge against the employers they blamed for depriving them of jobs. Even employed workers took part in the riots and wrecked the machines as a protest against their low wages and terrible working conditions. In 1769, Parliament passed a law making the destruction of some kinds of machinery punishable by death. But workers continued to riot against machines. In 1811, or-

Engraving (1850) by an unknown artist, Mansell Collection

Manufacturers sometimes hired children in outdoor markets for factory work in Britain. This engraving was intended as propaganda to protest the abuse of child labor in the country.

ganized bands of employed and unemployed workers called *Luddites* began attacking factories and wrecking textile machines. The Luddites received their name from their mythical leader, Ned Ludd. Their movement lasted until 1816.

The working and living conditions of the working class improved gradually during the late 1800's. Parliament, which had largely represented only the upper class, began to act in the interests of the middle and working classes. It repealed the law forbidding trade unions and passed other laws regulating factory conditions. In 1832, a Reform Act gave most middle-class men the right to vote. Another Reform Act, passed in 1867, granted the right to vote to many city workers and owners of small farms.

The middle and upper classes. Although the workers did not initially share in the prosperity of the Industrial Revolution, members of the middle and upper classes prospered from the beginning. Many people made fortunes during the period. The revolution made available products that provided new comforts and conveniences to those individuals who could afford them. The middle class, which was made up of business and professional people, won political and educational benefits. As the middle class gained in power, it became increasingly important in politics. By the mid-1800's, big business interests largely controlled British government policies.

Before the Industrial Revolution, England had only two universities, Oxford and Cambridge. But the revolution created a need for engineers and for clerical and professional workers. As a result, education became vital. Some libraries, schools, and universities were founded by private persons or groups, especially non-Anglican Protestants.

The Industrial Revolution indirectly helped increase Britain's population. As people of the middle and upper classes enjoyed better diets and lived in more sanitary housing, they suffered less from disease and lived longer. The material condition of the working class also improved. Partly as a result of these improved conditions, the population grew rapidly. In 1750, Britain had about 6 $\frac{1}{2}$ million people. By 1830, the population had increased to about 14 million.

Spread of the Industrial Revolution

The techniques of industrialization began to spread from Britain to other countries soon after the start of the Industrial Revolution. Britain attempted to maintain a monopoly of its discoveries and skills. British law prohibited the emigration of craftworkers until 1824 and prohibited the export of machinery until 1843. Nevertheless, hundreds of skilled workers and manufacturers left Britain, taking their knowledge of industrialization with them.

In 1750, John Holker, a Lancashire manufacturer, settled in France, where he helped modernize spinning techniques in the textile industry. Samuel Slater, a Derbyshire textile worker, emigrated to the United States in 1789 and later established a spinning mill in Rhode Island. William Cockerill, a Lancashire carpenter, moved to Belgium in 1799 and began to manufacture textile ma-

chinery. In 1817, Cockerill's son John established factories near Liège that produced bridge materials, cannons, locomotives, and steam engines.

Some manufacturers in Britain permitted people from other countries to inspect their factories. From 1810 to 1812, Francis Cabot Lowell, an American businessman, visited Lancashire textile mills. Lowell returned to the United States and established a textile factory in Waltham, Massachusetts. This factory was one of the first in the world to combine under one roof all the processes for manufacturing cotton cloth. In 1838, the famous German industrialist Alfred Krupp went to Sheffield, where he learned the most up-to-date processes for making steel.

The export of British capital became even more important than the export of people and machines in the spread of the Industrial Revolution. For hundreds of years, British merchants had extended credit and made loans to customers in other countries. As the Industrial Revolution grew, the flow of British capital to other countries increased. The flow became a flood with the coming of the railroad. British companies financed the export of locomotives, iron for rails, and experts to build and operate railroads in many countries.

Belgium became the second country to industrialize. Steam engines were first installed there in the early 1700's. Between 1830 and 1870, the nation rapidly developed its heavy industry with much financial support from the government. Textile making, which had been important in Belgium for many years, was industrialized. The cities of Ghent, Liège, and Verviers developed into major textile-manufacturing centers. Belgian coal fueled the textile factories.

France made little industrial progress before the 1790's. Industrialization was further slowed by the French Revolution (1789-1799) and by the wars of Napoleon Bonaparte, who ruled France during the early 1800's. After Napoleon left the throne permanently in 1815, the French government encouraged industrial development. But by 1850, more than half of France's iron production still came from old-fashioned and expensive charcoal furnaces. After 1850, however, coke rapidly replaced charcoal for smelting and puddling.

A poor transportation system crippled French industry during most of the 1800's. The transportation system had fallen into bad condition during the French Revolution and the Napoleonic Wars. Although the government deepened and widened many rivers and canals, these improvements did not meet the needs of growing industries in France. In 1842, the government also approved the building of a national railway system, but many complications forced long delays in its construction. France remained largely a country of farms and small businesses. After World War II (1939-1945), the

Lithograph by Engelmans, *La Vie du Rail* magazine, Paris

Railroads began playing an important part in transporting freight and passengers during the late 1830's. This lithograph shows horse-drawn and steam-powered trains in France in the mid-1800's.

French government began a series of national plans to modernize the economy.

Germany had the natural resources needed for industrialization, but political and social obstacles held the country back. Until Germany was unified in 1871, it was a collection of separate states that often failed to cooperate with one another in economic matters. In addition, a small group of landowners controlled much of the land. In the early 1800's, the government of the state of Prussia gradually took steps to provide for the industrial development of the land and its minerals. At the same time, Prussia succeeded in arranging agreements among the German states on common tariffs.

Between 1830 and 1850, the coal production in Germany doubled. About 1850, iron ore mining in Germany began to increase sharply. As a result, the number of furnaces fueled by coke increased rapidly as well. Foreign investors and new German investment banks provided money for the booming iron industry. In addition, Germany's steel production began to grow rapidly during the late 1800's. By 1900, its steel production exceeded that of Britain and ranked second to that of the United States.

The United States. The first industrialization outside Europe occurred in the British colonies that became the United States. The colonies had a wide range of industries. The most successful was shipbuilding. By the time the colonies declared their independence in 1776, about a third of Britain's ships were being built in America. Iron manufacturing was also a major industry, and a few American companies exported iron to Britain.

By the early 1800's, the small arms industry in the United States had developed machines and machine tools that could produce standard parts that were required for mass production (see **Mass production**). Industrial production, especially of textiles and light metals, began to increase sharply in the United States in the 1820's. The greatest increases in manufacturing took place in New England. Industrialization also benefited from improvements made in rivers and canals. These improvements reduced the cost of transporting goods to and from the interior of the country.

Beginning in the 1830's, industrialization increased rapidly throughout the Eastern United States. The iron industry in Pennsylvania made especially great advances as iron was adapted for agricultural tools, railroad track, and a variety of structural uses. By the 1850's, the quality and price of American iron enabled U.S. ironmakers to compete with British ironmakers in the international market.

During the mid-1800's, the agricultural, construction, and mining industries expanded as the population spread westward. Manufacturing accounted for less than a fifth of all U.S. production in 1840. By 1860, it accounted for a third. Agricultural products still made up more than two-thirds of the value of all U.S. exports in 1860, and the country still imported more manufactured goods than it exported. But by the late 1800's, the United States had become the largest and most competitive industrial nation in the world.

By 1870, the main trends of the Industrial Revolution were clearly marked in all industrialized countries. Industry had advanced more quickly than agriculture. Goods were being made by power-driven machinery and assembled in factories, where management planned operations and the workers did little more than tend the machines. Capital controlled industrial production, but labor was being allowed to organize to fight for higher wages, shorter hours, and better working conditions. The railroad, the improved sailing ship, the steamship, and the telegraph had reduced the cost and time of transportation and communication. Living standards of the workers in industrial countries were higher than they had ever been. Populations grew rapidly, and

Granger Collection

Steamships carried raw materials and manufactured goods across the Atlantic Ocean by the mid-1800's. Steamboats also carried much freight on British and American rivers and coastal waters.

more people lived in cities than ever before.

Margaret C. Jacob

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I. Life before the Industrial Revolution
II. Growth of the Industrial Revolution
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B. The steam engine
C. Coal and iron
D. Transportation
E. The role of capital
III. Life during the Industrial Revolution
A. The working class
B. The middle and upper classes
IV. Spread of the Industrial Revolution
A. Belgium
B. France
C. Germany
D. The United States

Questions

Who were the *Luddites?*
What was the *domestic,* or *cottage,* system?
What were probably the two most important industries in Britain during the Industrial Revolution?
What obstacles held back German industrialization during the early 1800's?
Why was the development of the steam engine important during the Industrial Revolution?
What role did James Watt play in steam engine development?
What are some reasons that the Industrial Revolution began in Britain during the 1700's?
Why were waterways important during the Industrial Revolution?
What was Francis Cabot Lowell's contribution to the Industrial Revolution in the United States?
Why was Henry Cort's puddling furnace important?
What role did banks play in the Industrial Revolution?

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Industrial union. See Labor movement (Types of unions).

Industrial Workers of the World (IWW) was a radical labor organization founded in 1905 to oppose the conservative policies of the American Federation of Labor (AFL). The AFL used *craft unions,* which separated workers by skills and trades. The IWW wanted to replace the craft unions with an organization of *industrial unions.* These unions would organize workers without regard to skill or trade. Members of the IWW, often called *Wobblies,* acted through strikes, boycotts, and sabotage.

The Wobblies shared many of the aims and methods of *syndicalism,* a movement to abolish capitalism and national government (see Syndicalism). In 1908, the Wobblies rejected the use of political action. They hoped to lead a general strike that would overthrow the capitalist system. They would then create a classless, socialist society in which workers would control the government and economy through industrial unions. However, the IWW had far too few members to achieve such a goal. Its membership probably never exceeded 100,000.

The IWW was formed in Chicago in June 1905 by members of the Western Federation of Miners and 42 other labor groups. IWW members also included immigrant workers in the Eastern United States and migrant workers in the South, the West, and the Great Plains. The group's influence reached its peak about 1912.

After the United States entered World War I in 1917, federal and state officials imprisoned many IWW leaders and disrupted many of the organization's strikes. IWW membership fell drastically after the war ended in 1918, as disputes among the Wobblies became more frequent. But by that time, the IWW had done much to expose the unfair working conditions of migrant workers in the Western United States. It had also developed ideas that later were used in forming modern industrial unions. David Brody

See also Labor movement (The Industrial Workers of the World; picture); Flynn, Elizabeth Gurley; Hill, Joe.

Industrialism. See Industrial Revolution; World, History of the (The Industrial Revolution).

John Gussman/Uniphoto

Agriculture (commercial greenhouse)

Kevin L. Martin

Construction (housebuilding)

Robert H. Glaze, Artstreet

Mining (strip mining coal)

Voscar/Uniphoto

Manufacturing (paper mill)

The many kinds of industry provide us with nearly all the products and services we use in daily life. Industry supplies food, housing, medical care, and many other needs. The pictures above and on the next page show some of the major industry groups as classified by the U.S. government.

Industry

Industry. An industry is a group of businesses that produce a similar product or provide a similar service. For example, companies in the automobile industry manufacture cars and trucks. Firms in the banking industry make loans, handle investments, and provide other financial services.

There are thousands of industries. They include advertising, construction, farming, meat packing, mining, and radio and television broadcasting.

Many industries change a raw material into a useful product. For example, the steel industry turns iron ore into steel. Some industries, such as railroads and trucking, move goods from place to place. Other industries provide such services as electric power, health care, and telephone communications.

The word *industry* also refers to all businesses together. In this sense, industry provides us with almost all our clothing, food, shelter, and other basic needs. Industry also helps make our lives healthier and happier by providing entertainment, labor-saving appliances, medicines, and many other things.

Although industry enriches the quality of life, it sometimes has harmful side effects. Factories can pollute the air and water and endanger our health. Machines make noise that is often unpleasant and may even damage hearing. Also, the rapid growth of industry may use up the world's supply of easily obtainable petroleum and natural gas.

This article discusses what industry needs for production, how industry varies around the world, and the problems and challenges faced by modern industry. The article also describes how industries are classified. To learn about the development of industry, see the articles **Industrial Revolution** and **Invention**. For detailed information on particular industries, see the *Related articles* listed at the end of this article.

William S. Comanor, the contributor of this article, is Professor of Economics at the University of California, Santa Barbara. He has written widely in the field of industrial organization.

What industry needs for production

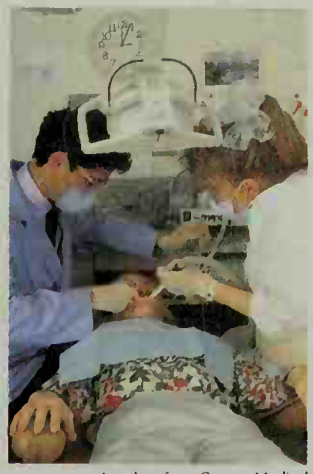
The experts who study industry use the term *output* for any item or service that an industry produces. An output could be a bolt of cloth, a refrigerator, or legal advice. To produce an output, a business uses such *in-*

John Gussman/Uniphoto

Transportation (urban transit system)

Robert Weinreb, Bruce Coleman Inc.

Finance (commercial bank)



© Amethyst from Custom Medical

Services (dental care)

Brent Jones

Retail trade (produce market)

Wayne LeNoue, The Photo File

Public administration (city council meeting)

puts as workers, machinery, and raw materials. The amount and quality of the output depend on the amount and quality of the inputs and on how well a producer uses them. Inputs are also called *productive resources.* Industry requires five basic inputs for production: (1) natural resources, (2) capital, (3) labor, (4) management, and (5) technology. Some experts list only three or four inputs because they consider management a form of labor or technology an aspect of capital. The total output divided by the total amount of labor used to produce it is called the rate of *labor productivity.*

Natural resources include lumber, mineral deposits, soil, sun, water, and wildlife. Resources are vital to agriculture, fishing, mining, and certain other industries. However, service industries, such as banking and insurance, require few of the earth's resources. In addition, some industries can substitute plastics and other synthetics for natural materials.

The supply of certain natural resources is limited. These resources are called *nonrenewable.* For example, the earth has limited deposits of coal, natural gas, and oil. Once used, they cannot be replaced. Other resources, such as fish and forests, are *renewable.* People can ensure a continuous supply of fish and trees by restocking bodies of water with fish and planting trees.

Capital has two meanings in connection with industry. (1) It refers to the money that a firm needs to hire workers, buy supplies, and pay bills. This money is called *working capital.* (2) Capital also means *capital goods*—that is, buildings, machinery, tools, and other goods that provide productive services over a period of time. In a bakery, the oven is a capital good, but flour and yeast are not. Some industries require a large investment in capital goods in relation to other expenses. Such *capital-intensive industries* include the electric power and the petroleum industries.

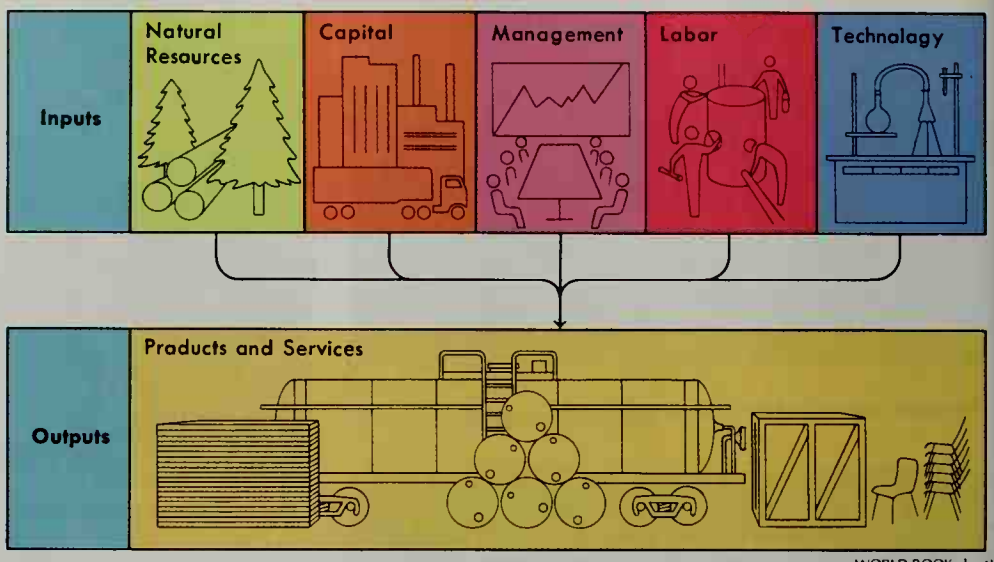
To increase production, industry must acquire more capital goods. However, the production of capital goods uses inputs or resources. To develop its industry, a nation must first use some resources to produce capital goods. Industry must give up the other goods that those resources could have produced. The use of resources to produce capital goods is called *investment* (see **Investment**).

A business can raise capital in three ways: (1) by borrowing money from a bank, (2) by issuing and selling bonds, and (3) by selling stock. When a business borrows from a bank, it promises to repay the loan with interest. A business can raise capital from investors who are willing to buy bonds issued by the business. The business promises to repay the value of the bond plus interest to the bondholder.

Another way of raising capital for business expansion involves selling stock in the business. The people who

What industry needs for production

To produce goods and services, industry requires natural resources, capital, management, labor, and technology. These basic needs are known as *inputs* or *productive resources*. Goods and services produced are called *outputs*.



WORLD BOOK chart

buy stocks are called *stockholders*. A business is not obligated to repay the money to stockholders. Instead, in return for their contribution, stockholders become additional owners of the business. Their ownership is represented by the shares of stock that they own. Although stockholders receive no repayments or interest from the business, they often receive *dividends* from the business. Dividends are a share of the profits from the business, and are paid according to the number of shares owned by a stockholder.

Labor is the work human beings do to produce goods and services. All industries require labor. However, some industries require far more money for labor than for other inputs, such as machines or materials. Such *labor-intensive industries* include accounting, law, and most other service industries.

The quantity of labor available to industry depends on several factors. These factors include the size of the population, the proportion of the population working or seeking work, and the hours each person works.

Labor also varies in quality. People differ in their inherited abilities and acquired skills. For these reasons, they differ in what and how much they can produce and in how skillfully they do their work. Education and training can increase a worker's skills. But education and training, like the accumulation of capital goods, require a present sacrifice to gain an expected future benefit. For this reason, the skills of the labor force are often referred to as *human capital*.

Management is a special kind of labor that makes business decisions. Managers decide such matters as what and how much to produce, which markets to serve, how much to advertise, and what prices to charge. They employ or manage the other inputs.

Managers of most businesses want high profits in order to pay high dividends to investors. For this reason, they aim to keep costs as low as possible. They also want to set high prices to gain high revenues. But competition within the industry often prevents them from doing so. Generally, a business will not increase the price of its output if its competitors will not increase their prices. If a business sets its prices higher than those of its rivals, many of its customers will buy the output of its rivals.

An important decision managers make is their choice of *input-mix*—what combination of capital, labor, and raw materials to use in production. The object is to keep production costs as low as possible. If labor costs are high, for example, a firm may invest in automatic machinery so that fewer workers are needed to accomplish the same task. If labor is cheap, the company may decide to employ extra workers instead of buying a machine to do the job. The combination of inputs that permits a firm to produce its goods or services at the lowest possible cost without reducing quality is called the *most productive*, or *optimum, input-mix*.

The goal of keeping production costs low also affects a company's choice of location. The resources an industry needs and the customers it serves are rarely close to each other. As a result, a business must transport inputs, outputs, or both. A business also tries to keep transportation costs as low as possible.

Transportation costs are based on weight and bulk as well as on distance. The location a company selects may thus depend on whether the company's product is heavier or lighter than the materials used to make it. The soft drink industry, which adds water to other ingredients to make its products, is an example of an industry that produces *weight-gaining products*. Soft drink companies choose locations near their customers. The paper and wood pulp industries are examples of industries that produce *weight-losing products*. Many such industries are near sources of raw materials.

Technology refers to a society's knowledge of machines, materials, techniques, and tools. A society can encourage technological progress by using more resources for such activities as education and research. However, gains in technology, like increases in capital, require a present sacrifice in order to achieve a future gain. For a detailed discussion of this aspect of industry, see the article Technology.

How industry varies around the world

Industry differs greatly between developed and developing nations. Developed nations include most countries in Europe and North America, as well as Japan. Developing nations include most countries in Africa, Asia, and Latin America. Industry in developed countries pro-

duces more goods and services per person than it does in developing ones.

The low production in developing nations is due to shortages of machinery and other capital goods, and to less advanced technology. Workers produce much food, shelter, and other needs with primitive tools and techniques, so that each worker's output is small. Unlike industrialized countries, developing nations also lack sufficient human capital, including the engineers, managers, and skilled workers needed for industrial growth.

Several obstacles restrict industrial expansion in developing countries. Rapid population growth prevents the expansion of capital because more resources must be used for food and other goods used directly by consumers. Most of the people spend everything they earn to survive and have nothing to invest. Among those people who are able to save, many invest their savings in gold, jewels, idle land, or other kinds of wealth rather than in capital goods. In addition, a shortage of schools and teachers limits the production of human capital.

Developing nations also differ from developed countries in what they produce. A large share of the industry in developing countries provides food and other basic needs. In developed countries, many industries produce leisure products and luxuries of various kinds. In addition, many poor nations produce only one or two raw materials, which they exchange with the rest of the world. They suffer if the price of these materials falls. See Developing country.

Donald Smetzer from The Marilyn Gartman Agency

In a developing nation, workers like these Iranian rug weavers produce many goods by hand with ancient tools and techniques. As a result, each worker's output is small.

Galaxy Carpet Mills, Inc.

In a developed nation, most industries have high-speed machinery like the carpet looms shown above. Such equipment increases the amount each worker can produce and thus provides more goods per person.

Problems and challenges

Modern industry faces many problems and challenges. Industry's most important problems include labor productivity, energy supply, and government regulation. In addition, industrial societies face such challenges as environmental pollution and unemployment.

Labor productivity. Businesses continually strive to produce more output with the same amount of labor. When productivity improves, firms can lower prices and still have enough money for the inputs used in production. They can also pay higher wages to workers and managers, and can give bigger dividends to their stockholders.

Higher rates of productivity also give businesses an advantage in international markets. Firms in the same industry compete with one another throughout the world. For example, European automakers compete with Japanese car companies for customers in many countries. In most cases, customers will buy the products that offer the best quality at the lowest price, regardless of where they are produced. A high rate of labor productivity enables businesses to offer better and cheaper products.

Many factors affect labor productivity, but one of the most important is the *structure* of an industry—that is, whether production is concentrated in one company or a few companies, or spread out among many firms. Most industries dominated by a single firm have little competition, which typically leads to low rates of productivity. As a result, such industries may fall behind similar industries in other countries. An example is the United States steel industry, which for many years was dominated by a single large company. Until the 1980's, that industry operated with outdated equipment and processes. It found itself losing business to steel industries in Japan, Canada, South Korea, and other countries, in part because some of those countries used modern equipment and methods to produce cheaper steel.

Industries with many firms, however, may do much better. Labor productivity and product quality often increase rapidly in such industries. An example is the U.S. pharmaceutical industry, which has many firms that compete vigorously. As a result, the industry produces high-quality drugs and medicines that are used throughout the world. For more information about structure, see the section on *Structure* later in this article.

Energy supply. Industry requires huge amounts of energy to run machines and to provide heat for manufacturing processes. The cost and availability of energy play major roles in the choice of industrial location and other business decisions. Industry also produces automobiles, heating systems, and other goods that require energy. Most energy today is generated from such natural resources as coal, natural gas, and petroleum.

Because these natural resources cannot be replaced, some people believe that government should control energy prices and limit individual and industrial use of fuel and electricity. But most economists call for less government intervention. They argue that past energy shortages resulted from government policies which kept the prices of petroleum and natural gas artificially

David R. Frazier

Recycling conserves natural resources used by industry and reduces pollution that results from the disposal of wastes. These cans and other goods are recycled for their aluminum.

low. They believe that if the government allowed the prices to rise, the higher prices would encourage energy producers to increase their output. Higher prices would also stimulate the development of substitute sources of energy. See the article **Energy supply** for more information on the energy problem.

Government regulation. The term *regulated industry* refers to industries in which government agencies control prices, standards of service, or some other aspect of the business. Industries regulated by the U.S. government include radio and television, which are supervised by the Federal Communications Commission (FCC); and the drug industry, whose products are controlled by the Food and Drug Administration (FDA). Other regulated industries include such public utilities as electric, gas, and telephone companies, which operate under state public service commissions. Many public utilities have a monopoly on their service within a given area. The United States government permits such monopolies but regulates the prices they charge and their activities.

However, nearly all United States industries are subject to some government regulation. The Occupational Safety and Health Administration (OSHA) enforces job safety and health standards. The Food and Drug Administration (FDA) administers laws on the purity of food and the safety and effectiveness of drugs. The Consumer Product Safety Commission sets safety standards for consumer goods. The Environmental Protection Agency (EPA) issues regulations dealing with automobile exhaust and gasoline mileage. The Federal Trade Commission (FTC) and the Department of Justice enforce laws that prohibit monopolies or monopolistic behavior.

Government regulation protects consumers from environmental pollution, unsafe products, and dishonest advertising and trade practices. But regulation may also harm consumers. For example, the lack of competition in a regulated industry could cause companies to become inefficient and to neglect product improvement. In such cases, members of society pay several times—not only in higher taxes and higher prices but also in poorer-quality products and services. See **Government regulation**.

Environmental pollution is a side effect of many industrial processes. Some factories pour smoke and other pollutants into the air and dump waste products into lakes and rivers. Pollution harms the environment and can endanger the health of living things.

To fight pollution, industries can install filter systems to remove harmful substances from waste products. They can develop production methods that create less pollution. They can also find ways to make useful products from waste substances. For example, sewage can be turned into fertilizer or fuel. Aluminum cans, glass and plastic bottles, and paper products can be recycled.

But fighting pollution uses resources, just as producing goods and services does. Pollution control devices and new processes that reduce pollution require capital, labor, technology, and other inputs. They may mean higher prices for consumers or lower profits for industry. See **Environmental pollution** for more information.

Unemployment results in lost income for the jobless, reduced sales for industry, and lost production for society as a whole. High unemployment occurs during economic slumps, when many businesses reduce production and lay off workers. People who have lost their jobs spend less on goods and services, and the reduced demand leads to still more joblessness. Unemployment also can result if consumer tastes change or new products are developed, causing some industries to decline. To fight unemployment, the government may help create jobs by increasing its spending or reducing taxes. It may also reduce interest rates and increase the availability of money and loans.

Even if jobs are available, unemployment can occur if workers lack the skills needed for those jobs. Many individuals cannot find work, and many businesses cannot find skilled workers. In the United States, the federal, state, and local governments have worker-training programs to help combat this type of unemployment. For additional information, see the article **Unemployment**.

How industries are classified

In an attempt to organize the vast amount of information about industry, economists have developed various classification systems. Each system groups industries that are similar in some way. One common system is the United States Standard Industrial Classification (SIC) used by the federal government. But for certain purposes, other systems are more suitable.

The U.S. SIC groups industries that use similar raw materials and production techniques. It classifies businesses into 11 major divisions, each represented by a letter of the alphabet. The divisions are (A) agriculture, forestry, and fishing; (B) mining; (C) construction; (D) manufacturing; (E) transportation, communications, electric, gas, and sanitary services; (F) wholesale trade; (G) retail trade; (H) finance, insurance, and real estate; (I) services; (J) public administration; and (K) nonclassifiable establishments.

The 11 divisions are divided into 84 major industry groups, each designated by a two-number code. These codes are further divided into three-number and four-number codes, representing increasing specialization. For example, code 01 in major division A covers busi-

nesses engaged in agricultural production. Code 011 applies to farms that produce grains for sale rather than for consumption on the farm, and code 0112 refers to rice growers.

Other systems of classification are more useful than the SIC for some purposes. To study price competition or the effectiveness of advertising, economists may group products that are close substitutes for one another. For example, tin cans and glass jars serve many of the same purposes. But they fall into different major industry groups under the SIC because different materials and processes are used to manufacture them.

For some studies, economists divide industries into those that manufacture *durable goods,* such as appliances and furniture, and those that produce *nondurable goods,* such as clothing and food. During periods of economic decline, durable goods industries suffer more than nondurable goods industries. People can postpone buying new furniture, but they must purchase food and medicine.

Industries can also be divided into those that produce *consumer goods* for sale to individuals and those that make capital goods, also called *producer goods,* for sale to business firms. Consumer goods include clothing, household articles, toys, and other items for personal use. Capital goods include tractors, machinery, and tools as well as steel and various chemicals used to make other products.

Another method of industrial classification depends on the industry's stage of production. Industries such as agriculture, fishing, and mining belong to the first stage of production, in which natural resources or raw materials are obtained. These industries are called *primary industries* or *extractive industries.* The chemical, textile, and other manufacturing industries make up the second stage of production, in which raw materials are turned into finished goods. They are called *secondary industries* or *fabricating industries.* The third stage involves the movement of goods from producers to consumers. Industries at this stage of production include automobile dealers, drugstores, and trucking firms. They are known as *tertiary industries* or *distributive industries.*

Industrial organization

A specialized field of economics called *industrial organization* investigates how industries are organized, how they work, and how their organization affects how they work. Economists who study industrial organization concentrate on three main areas: (1) structure, (2) behavior, and (3) performance. All three affect one another in many ways.

Structure describes the way in which individual businesses together form an industry. It includes such factors as the number of firms in an industry, their sizes, and how difficult it is for new firms to enter the industry.

An important characteristic of industrial structure is called *concentration*—that is, the proportion of an industry's total output supplied by a few firms. For example, a few large companies produce nearly all the aluminum and most of the laundry detergents sold in the United States. A highly concentrated industry, which is dominated by a few large businesses who control the supply, is known as an *oligopoly.* In a *monopoly,* one business controls the supply of a particular product or service for which there is no close substitute available.

The degree of concentration in an industry depends partly on how much increased production will lower the cost per unit of making the product. Some of a firm's costs stay the same whether it produces 100 items a day or 1,000. Its property taxes probably will not rise, nor will the cost of heating or cooling the factory. The machinery will wear out faster with increased use but not 10 times faster. If the cost per unit of making the product declines as the output increases, the business benefits from a condition called *economies of scale.* In this case, smaller firms have higher costs than do larger firms. As a result, new firms may have difficulty entering the industry, and small firms may be forced out of business.

In some industries, established firms have advantages over a new company trying to enter the industry. For example, many types of manufacturing require such large factories and such expensive equipment that it is difficult for new businesses to begin production. Established firms may also control the supply of raw materials, or one company may own patents covering the manufacturing process. Obstacles that discourage newcomers are called *entry barriers.*

A type of business structure in which one company operates at more than one stage of production is called *vertical integration.* A vertically integrated steel company might produce raw materials at its own coal and iron mines and make finished products at its own steel mills. Vertical integration sometimes reduces shipping costs and other expenses. For example, a steel mill may not only make steel from iron ore but also roll the steel into sheets before it cools. This operation saves the cost of reheating the metal.

A firm that produces a number of largely unrelated goods and services is said to be *diversified.* A diversified company might make silverware, zippers, and a variety of other products. Diversification gives a company more financial security than it would have if it produced only one kind of product. Because a diversified company operates in various industries, it can sometimes offset declines in one industry with advances in another.

Behavior refers to how businesses act in relation to one another and in response to economic conditions. It includes such factors as what prices companies charge, what advertising and other sales promotion they do, and how much each firm spends to develop new products.

Industrial behavior is related to industrial structure. For example, if an industry includes many firms, the competition among them will often be intense. Each will try to offer a better or cheaper product than the others. The competitors may even spend large sums on advertising, packaging, customer service, and other means of sales promotion. The fewer the number in an industry, on the other hand, the easier it is for them to act together to set prices. In an oligopoly, few companies supply a good or service so that each of them can influence the price, with or without a definite agreement among them.

Entry barriers also influence behavior. By discouraging new firms from entering an industry, entry barriers enable established firms to charge higher prices and to be less efficient.

A company's degree of diversification can also affect

its behavior. A diversified business may be more likely than a nondiversified business to spend money developing new technologies that can be used for the various products it produces.

Performance refers to the results of industry behavior and structure. It refers to how well an industry meets the needs of a society in producing high-quality products, setting low prices, and providing employment. The performance of all industries together determines the performance of a nation's economy.

Three measures of an industry's performance are its *technical efficiency, allocative efficiency,* and *dynamic efficiency.* Technical efficiency is the ability to produce an output without waste. Allocative efficiency is the degree to which an industry produces the type and level of output that consumers want. Dynamic efficiency describes the extent to which an industry succeeds in developing new and improved products and in reducing costs and prices. William S. Comanor

Related articles. See Business and Manufacturing. See also the *Economy* section of the state, province, country, and continent articles. Additional related articles include:

Natural resource industries

Agriculture
Coal
Dairying
Fishing industry
Forest products
Gas
Lumber
Mining (The mining industry)
Petroleum (The petroleum industry)

Manufacturing and processing industries

Aluminum
Automobile (The automobile industry)
Building construction
Clothing (The clothing industry)
Drug (How drugs are produced and sold)
Electronics
Food (The food industry)
Furniture
Glass
Iron and steel
Leather
Meat packing
Paper
Plastics
Printing
Publishing
Rubber (The rubber industry)
Textile (The textile industry)

Service industries

Bank
Communication
Dry cleaning
Education
Government
Hotel
Insurance
Motel
Motion picture (The motion-picture industry)
Public utility
Real estate
Recording industry
Restaurant
Service industries
Television (The U.S. television industry; Television throughout the world)
Transportation

What industry needs for production

Capital
Labor force
Natural resources
Personnel management
Technology

Other related articles

Antitrust laws
Assembly line
Automation
Conglomerate
Consumption
Corporation
Deming, W. Edwards
Economics
Environmental pollution (Business and industry)
Factory
Government ownership
Hazardous wastes
Industrial relations
Input-output analysis
Marketing
Mass production
Monopoly and competition
Multinational corporation
Nationalization
Price
Production
Productivity
Profit
Supply and demand
United Nations Industrial Development Organization
Value added by manufacture

Outline

I. What industry needs for production
A. Natural resources
B. Capital
C. Labor
D. Management
E. Technology
II. How industry varies around the world
III. Problems and challenges
A. Labor productivity
B. Environmental pollution
C. Energy supply
D. Unemployment
E. Government regulation
IV. How industries are classified
A. The U.S. SIC
B. Other systems of classification
V. Industrial organization
A. Structure B. Behavior C. Performance

Questions

What are some advantages of increased labor productivity?
When does a business benefit from a condition called *economies of scale*?
What is a *monopoly*? An *oligopoly*?
What are the five basic inputs industry needs for production?
How do *consumer goods* differ from *capital goods*?
What are some industries supervised by the United States government?
What are some factors that give established firms an advantage over new firms entering the market?
How does industry in developing countries differ from that in developed nations?
What two meanings does the term *capital* have in connection with industry?
What is a *labor-intensive* industry?

Additional resources

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Inert gas. See Noble gas.

Inertia, *ihn UR shuh,* is a property of all matter. It makes an object that is not moving continue motionless unless some force puts the object into motion. In addition inertia makes a moving object continue to move at a constant speed and in the same direction unless some outside force changes the object's motion. Only an outside force can make a moving object slow down, speed up, stop, or turn. One type of outside force that commonly slows or stops a moving object is friction with other objects.

The force required to change an object's motion depends on the *mass* of the object. Mass may be defined as the amount of matter in an object. The greater an object's mass, the harder it is to put the object into motion or to change its direction or speed. For example, a locomotive has more mass than an automobile. Therefore, it takes more force to stop a locomotive than to stop an automobile in the same amount of time when both are traveling at the same speed. Because of the relationship between inertia and mass, physicists usually define mass as a measure of inertia rather than as a measure of matter.

WORLD BOOK photos by Ted Nielsen

A simple way to demonstrate inertia. Balance a coin on a card at the end of a finger. Now snap the card out from under the coin—without touching the coin. The card goes flying away, but inertia will keep the coin on your fingertip.

The difficulty involved in changing the direction or speed of an object also depends on how quickly the change is made. It is harder to slow down, speed up, or turn a moving object suddenly than to make the same change gradually. An automobile has more difficulty holding the road on a curve at high speed than at low speed. Physicists use the term *acceleration* to describe the rate of change in an object's direction or speed.

The English scientist Sir Isaac Newton first described inertia. He introduced the idea in his first law of motion, which was published in 1687. Gregory Benford

See also **Centripetal force; Force; Mass; Matter; Motion** (Newton's laws of motion).

Inertial guidance is a method of guiding a submarine, missile, spacecraft, or other vehicle by continuously monitoring its position and acceleration, and adjusting its course. Unlike other methods of navigation, inertial guidance does not rely on information from outside the vehicle, such as observations of land or the stars, or radio or radar signals. Instead, it relies on *inertia,* the tendency of a moving object to resist a change in direction. In wartime, enemies cannot "jam" an inertial guidance system with false or confusing information.

An inertial guidance system, also called an *inertial navigation system* or *inertial reference system,* consists of stabilizing devices, measuring devices, and a computer to calculate the vehicle's position and guide it on its course. The stabilizing devices are *gyroscopes,* which maintain a constant direction. The measuring devices are *accelerometers,* which detect changes in speed and direction.

An inertial navigation unit measures how far a vehicle has traveled by recording changes in the position of a *vertical line.* This line indicates the direction to the center of the earth. Vertical lines from any two points on the earth meet at the center of the planet. The angle between the lines shows the distance between the points. Each *minute* (one-sixtieth of a degree) of angle indicates a surface distance of 1 *nautical mile* (6,076.1 feet, or 1,852 meters). New York City is 3,006 nautical miles from London. Therefore, a pilot flying from New York City to London knows the airplane has gone far enough when the vertical line of the inertial navigator has moved through an angle of 3,006 minutes (50°, 6 minutes).

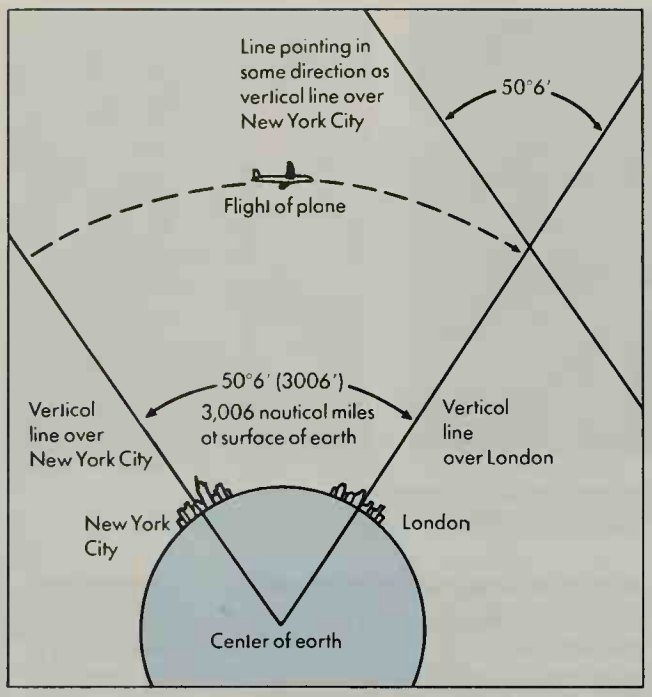
Any error in an inertial guidance system will increase the farther a vehicle travels. To reduce navigation errors, a system constantly checks its output against an independent source of position information and corrects it when necessary. Such sources include radio beacons on the ground and the Global Positioning System, a worldwide system of navigation satellites (see **Global Positioning System**).

Gyroscopic systems have long been used in inertial guidance. Inside a gyroscopic system, three wheellike gyroscopes, called *gyros* for short, spin in different directions on axles. The axles form 90° angles with one another, like three edges of a box meeting at a corner. The axles keep their directions as long as the gyros spin. The gyros stabilize a type of table called a *platform* so that it remains horizontal to the earth's surface even when the vehicle rolls, pitches, or turns. The accelerometers, which are mounted on the platform, detect changes in the vehicle's motion in reference to the stable set of directional lines defined by the gyroscopes.

When a missile, fighter airplane, or other vehicle turns, dives, or climbs sharply, a platform may move from its horizontal position. A platform that leaves horizontal is said to "tumble." A tumbled platform will not work until it has been reset to horizontal.

Strap-down systems are rigidly fastened to aircraft and do not depend on platforms. They incorporate *ring laser gyros* (RLG's) or *fiber-optic gyros* (FOG's). These instruments are not true gyroscopes, but they perform a similar function using light waves. An RLG or FOG sends two beams of light around a loop in opposite directions. The two beams meet on a detector, forming an *interference pattern* (series of bright and dark bands), which indicates differences in the routes the beams have taken. When the RLG or FOG turns, the interference pattern changes, and a computer calculates direction based on variations in the pattern. RLG's and FOG's can withstand violent motion better than traditional gyroscopes can.

History. Navigators have known the principles of inertial guidance since the early 1900's. Ships have used gyroscopes as compasses since that time. Unlike magnetic compasses, these *gyrocompasses* always indicate true north and are not affected by steel. In 1923, the German engineer Max Schuler described a method for establishing a vertical line that would not tilt when a vehicle changed speed or direction.



WORLD BOOK diagram

Inertial guidance on a flight from New York City to London is illustrated in this greatly simplified diagram. A gyroscope in the guidance system keeps pointing in the same direction as a vertical line over New York City. The system measures the angle between a line pointing in that direction and a vertical line from the plane to the earth's surface. When the angle is 50° 6′, the plane is over London.

During World War II (1939-1945), German scientists built an inertial guidance system that guided their V-2 rockets against England. In the late 1940's and early 1950's, the American engineer Charles S. Draper and other scientists at the Massachusetts Institute of Technology built the first highly accurate inertial guidance systems. In 1958, two United States submarines used inertial navigators to guide them under the Arctic ice to the North Pole. Since the early 1960's, many submarines and missiles have been equipped with inertial navigators. Space shuttles and other spacecraft also use inertial navigators. The United States requires commercial overseas flights to have inertial guidance systems. Some land vehicles, such as tanks, also use inertial guidance systems. Albert Helfrick

See also **Guided missile** (Preset guidance); **Gyrocompass**; **Gyroscope**; **Navigation**.

Infant. See **Baby**.

Infant mortality is a measure of the number of infants who die before reaching their first birthday. Infant mortality rates tell how many babies die each year for every thousand babies that are born. Because the rates reflect the well-being of the most dependent members of a society, they are often interpreted as a measure of how well the society is able to take care of its people. For this reason, comparing infant mortality rates of different nations or communities is a way of evaluating a society's standard of living.

Deaths during the first year after birth are divided into two categories, depending on when they occur. *Neonatal deaths* occur during the first 27 days after birth. *Postneonatal deaths* occur from 28 days of age to age 1. Factors that contribute to a baby's death are different in each of these two periods. Neonatal deaths are usually related to conditions that the infant is born with. For example, many neonatal deaths occur because the infant was born too early or too small to ensure survival. Postneonatal deaths are more often related to the infant's living environment after birth. Common factors in such deaths include whether the baby gets immunizations against communicable diseases and whether the infant is provided adequate food, shelter, and health care.

Infant mortality rates

Infant mortality rates tell how many babies out of every 1,000 live births die during their first year. This table lists infant mortality rates for 20 selected countries.

Finland	4	**Mexico**	30
Japan	4	**China**	31
Canada	5	**Brazil**	33
Czech Republic	5	**Vietnam**	34
United Kingdom	6	**Egypt**	49
United States	7	**India**	84
Costa Rica	13	**Pakistan**	94
Russia	17	**Cambodia**	102
Argentina	19	**Iraq**	103
Iran	26	**Sierra Leone**	169

Figures are for 1998.
Source: World Bank.

Infant mortality rates vary greatly worldwide. The highest rates occur in developing nations in Africa, Asia, and Central and South America. The lowest infant mortality rates are found in industrialized countries that offer comprehensive health care, such as Finland, Japan, and Sweden. Infant mortality rates in the United States are high compared to other developed nations, in part because of the high rates of infant death among impoverished minority groups. Arden S. Handler

Infanticide is the intentional killing of a child less than 1 year old, usually by a parent. Infanticide committed within 24 hours of birth is called *neonaticide*. People and cultures throughout history have used infanticide as a means of dealing with overpopulation, children whom they regard as undesirable, or the inability to provide proper care. Infanticide deaths usually occur by drowning, strangulation, suffocation, or abandonment. The practice is outlawed throughout the civilized world.

There are five main categories of infanticide: (1) *altruistic infanticide,* which is intended to relieve real or perceived suffering in the child; (2) *acutely psychotic infanticide,* in which a person kills while experiencing severe mental illness; (3) *accidental infanticide,* where there is no homicidal intent; (4) *spousal revenge infanticide,* in which one parent kills a child to hurt the other parent; and (5) *unwanted child infanticide,* in which the infant is not desired. A common form of unwanted child infanticide is the killing of female babies that occurs in some countries because of a cultural preference for male children. Other infants may be killed as unwanted because they have a disease or abnormality.

The practice of infanticide dates back to ancient times. Many early civilizations, including ancient Greece and Rome, practiced widespread infanticide. In 1922, England passed an infanticide law, allowing for charges of manslaughter, but not murder, when a mother kills a

newborn. Since then, governments have struggled with what actions to take against those who commit the crime. Common methods include imprisonment, community service, fines, psychological counseling, and participation in educational programs. Neil S. Kaye

Infantry has been the largest combat branch of most armies for hundreds of years. It is made up of soldiers who fight on foot.

Divisions. In the United States Army, infantry divisions are made up of varying numbers and types of battalions and support groups. A typical *mechanized infantry division* is divided into five mechanized battalions and five armored battalions and has about 16,000 soldiers. A typical *light infantry division* consists of nine infantry battalions and has about 10,000 soldiers. U.S. Marine infantry divisions are called *marine divisions.* Each has about 19,000 soldiers grouped into three infantry regiments, an artillery regiment, and five battalions.

The infantry divisions of other countries are organized according to their own methods of warfare. In some countries, infantry soldiers may serve in *motorized rifle divisions* or may be assigned to *tank divisions,* where they travel in armored fighting vehicles.

Equipment. Infantry divisions are equipped with rifles, machine guns, grenades, antiarmor missiles, mortars, recoilless rifles, artillery, and armored fighting vehicles. These units are also equipped and trained for transportation by air. With field telephones and radios, infantry units can call for artillery or air support.

History. Large masses of foot soldiers fought in ancient wars. But the importance of infantry declined during the A.D. 500's as cavalry began to dominate the battlefield. In the 1300's, the development of the English longbow, the Swiss pike and halberd, and firearms renewed the importance of infantry. In the major wars of the 1900's—World Wars I and II, the Korean War, and the Vietnam War—infantry divisions did most of the fighting. Joel Slackman

See also **Army, United States** (Infantry); **Artillery** (Field artillery); **Machine gun.**

Infertility, *IHN fur TIHL uh tee,* in human beings, is the inability of a man and a woman to produce children together. Both the man and the woman might be able to have children with other partners. For this reason, experts usually regard infertility as a condition of the couple rather than of either individual. Infertility may be temporary and treatable, or it may be permanent. Permanent infertility is called *sterility.* Experts also consider couples who have repeated miscarriages to be infertile.

Causes. Infertility may result from abnormal development, abnormal function, or disease of the reproductive system. In some cases, the condition can be traced to one specific disorder in either the man or the woman. But much of the time, infertility results from a number of factors involving both partners.

Male infertility frequently occurs because of problems with sperm. In these cases, laboratory tests of sperm samples usually reveal an absence of sperm, a low sperm count, or a high percentage of abnormal sperm. Other causes of male infertility include infections and malfunctioning glands. Most commonly, however, doctors cannot determine a specific cause.

Many cases of female infertility involve blockage of a woman's *fallopian tubes,* which transport eggs from the ovaries to the uterus. Fertilization of an egg by a sperm usually occurs in one of these two tubes. Blocked fallopian tubes stop eggs from entering the uterus, where a fertilized egg develops into a fetus. Sexually transmitted diseases are the main cause of such blockage.

Two other causes of female infertility are *anovulation* and *endometriosis.* Anovulation is the failure of a woman's ovaries to release eggs. This failure is caused by disorders involving endocrine glands, especially the ovaries, the hypothalamus, and the pituitary. Endometriosis is a disease that may harm the function of a woman's ovaries and other reproductive organs.

Treatment. In both men and women, surgery can often correct infertility caused by blockages or other structural disorders of the reproductive organs. For example, surgeons may open blocked fallopian tubes. Doctors treat infections of the reproductive system with antibiotics. Hormone treatment may correct infertility caused by malfunctioning glands.

Doctors prescribe drugs called *fertility drugs* to improve production of both sperm and eggs. In women, fertility drugs often stimulate production of more than one egg, which can result in a multiple pregnancy. Doctors can prevent multiple pregnancies by using ultrasound to monitor the ovaries. As soon as the first egg matures, the patient stops taking fertility drugs.

Infertility caused by sperm problems can be treated with a procedure called *artificial insemination.* In this procedure, a doctor places sperm from a woman's partner or a donor directly into her reproductive system.

During the late 1900's, experts developed a group of advanced infertility treatments called *assisted reproductive technology* (ART). Doctors perform ART procedures for patients with severe infertility that cannot be treated by other means. Examples of such patients are women with blocked fallopian tubes that cannot be opened surgically and men with extremely low sperm counts.

The most common ART technique is called *in vitro fertilization,* in which eggs and sperm are combined in a laboratory dish. If the unfertilized eggs and sperm are then placed into a woman's fallopian tubes, the procedure is called *gamete intrafallopian transfer,* often shortened to GIFT. When fertilized eggs (also called *zygotes*) are placed in her fallopian tubes, the technique is called *zygote intrafallopian transfer,* often shortened to ZIFT).

Once fertilized eggs begin to divide, they become *embryos.* When dividing eggs are placed in a woman's uterus, the procedure is called *embryo transfer.* When embryos are placed in her fallopian tubes, this procedure is known as *tubal embryo transfer* (TET). In some cases, embryos may be frozen for later use.

The eggs and sperm may come from the couple being treated or from donors. The woman who produces the eggs takes fertility drugs to make several eggs mature at once. Using several eggs increases the likelihood of successful pregnancy. When a man has an exceptionally low sperm count, doctors sometimes achieve fertilization by using tiny instruments to insert individual sperm into eggs. This delicate technique is called *intracytoplasmic (IHN truh SY tuh PLAZ mihk) sperm injection,* often shortened to ICSI. W. Paul Dmowski

See also **Endometriosis; Fallopian tube; Fertilization; Reproduction, Human; Sterility.**

Infinitive. See **Adverb; Verb.**

Infinity is a term commonly used to refer to a quantity or distance that is so large it cannot be counted or measured. In mathematics, the idea of infinity forms an important part of set theory.

A set of objects or numbers is called *finite* if the objects or numbers can be paired with the positive *integers* (whole numbers) less than some positive integer. For example, a set of playing cards of one suit, which consists of 13 members, is finite. The cards can be paired with the positive integers less than 14.

An *infinite* set is one that is not finite. Its members cannot be paired with the positive integers less than some positive integer, because the set continues without end. For example, the set of all positive integers—1, 2, 3, 4, and so on—is infinite, as is the set of all fractions. Both sets have an unlimited number of members.

Infinite sets may be represented by placing three dots after the last member noted. For example, the set of even numbers above zero may be written 2, 4, 6, ... The symbol ∞ also represents infinity.

The idea of infinity has other applications in mathematics in addition to set theory. In projective geometry, for example, the *point at infinity* is defined as the intersection of all parallel lines. Donald R. Kerr, Jr.

See also **Set theory** (Finite sets and infinite sets).

Inflammation is a response by the body to injury or infection. It causes redness, swelling, heat, and pain, and it impairs the function of the affected organ or tissue. The response brings white blood cells called *leukocytes,* which are part of the body's immune system, to the site of injury or infection. Inflammation, together with the immune system, removes infectious organisms and destroyed or damaged tissues, and begins healing. Chemicals called *chemokines* and *cytokines,* released by leukocytes, organize the body's inflammation response.

Inappropriate or uncontrolled inflammation can damage healthy tissue. Rheumatoid arthritis and some other diseases are caused by such inflammation. Inflammation also occurs when the blood supply to an organ or tissue is interrupted and later restored, as in heart attack or stroke. This inflammation can cause further tissue damage. Scientists think inflammation also plays a role in such other diseases as Alzheimer's disease, arteriosclerosis, multiple sclerosis, diabetes, and some cancers.

Treatments for inflammation aim to relieve the symptoms such as fever, pain, and swelling. Anti-inflammatory drugs include *corticosteroids* and nonsteroidal drugs such as aspirin. Scientists are developing new drugs to treat inflammation that work by blocking cytokines, chemokines, and other molecules that promote inflammation. Klaus Ley

Inflammatory bowel disease is the general term for two disorders that cause irritation, swelling, bleeding, and open sores in the digestive system. These disorders are *ulcerative colitis* and *Crohn's (krohnz) disease.*

Ulcerative colitis inflames the *rectum* (last part of the large intestine). Inflammation may also extend into the *colon* (main part of the large intestine). The disorder affects the layer of tissue that lines these organs. Symptoms of ulcerative colitis include abdominal cramps and bleeding from the rectum. Diarrhea also occurs because inflammation prevents the intestine from absorbing liquid, leading to watery stools. Ulcerative colitis that lasts more than 10 years increases the risk of colon cancer.

Crohn's disease can inflame any digestive organ from the mouth to the *anus* (outside opening of the rectum). Inflammation usually extends into the muscles and other tissues enclosing these organs. The disease may completely penetrate an organ and create an opening to neighboring structures. Inflammation can occur in patches, separated by areas of normal tissue. Symptoms depend on what areas are inflamed and can include vomiting, diarrhea, fever, and weight loss. The deep inflammation causes severe pain and can block the intestine. The skin, eyes, or joints may also become inflamed.

Causes. Doctors do not yet know what causes inflammatory bowel disease (IBD), but they have seen patterns in how IBD occurs. For example, IBD usually starts when people are in their teens or 20's. IBD occurs more often in industrialized countries than in the developing world.

Doctors suspect that *genes* (units of heredity) are involved in IBD because the disease runs in families. But no specific inheritance pattern or abnormal genes have been discovered. One theory is that IBD involves several genes as well as other factors, which may include microbes, the immune system, or unknown causes.

Diagnosis and treatment. To diagnose IBD, doctors must rule out other causes of inflammation, such as infections or an inadequate blood supply. Diagnosis usually involves X rays and *endoscopic (EHN duh SKAHP ihk)* studies, in which doctors view the digestive organs directly through a thin, lighted tube. Samples of inflamed tissue may also be examined under a microscope.

IBD is a *chronic* (lifelong) disease. Doctors treat IBD with drugs that reduce inflammation. Surgeons can cure severe, long-lasting ulcerative colitis by removing the colon and rectum. Surgery does not cure Crohn's disease, but may be used to remove sections of inflamed or blocked intestine when medical treatment is not effective. Some Crohn's patients receive nutritional supplements. Stephen B. Hanauer

See also **Colitis; Colon cancer; Crohn's disease.**

Inflation is a continual increase in prices throughout a nation's economy. The rate of inflation is determined by changes in the *price level,* an average of all prices. If some prices rise and others fall, the price level may not change. Therefore, inflation occurs only if most major prices go up.

Inflation reduces the value—also called the *purchasing power*—of money. During an inflationary period, a certain amount of money buys less than before. For example, a worker may get a salary increase of 10 percent. If prices remain stable, the worker can buy 10 percent more goods and services. But if prices also increase 10 percent, the worker's purchasing power has not changed. If prices rise more than 10 percent, the worker cannot buy as much as he or she previously could.

Inflation has many causes. It may result if consumers demand more goods and services than businesses can produce. It may also occur if employers grant wage increases that exceed gains in productivity. The employers pass most or all of the cost of the wage increase along to consumers by charging higher prices. A government can try to control inflation by increasing taxes, raising interest rates, decreasing the money supply, reducing government spending, and limiting wages and prices. But the government's task is difficult, chiefly because it may trigger a recession when it tries to reduce inflation.

The opposite of inflation is *deflation,* a decrease in prices throughout a nation's economy. Deflation tends to occur during periods of economic depression but may also happen at other times. For a discussion of the economic conditions sometimes associated with deflation, see Depression.

Measuring inflation

Economists use measurements called *indexes* to determine changes in the price level. The indexes compare current prices with prices of an earlier period called the *base period.*

The most widely used price index in the United States is the *Consumer Price Index* (CPI). The CPI measures monthly changes in the price of a group of goods and services that people buy regularly. Such items include food, clothing, housing, and medical care. The total price of these items is compared with their total price during a base period. In 1995, for example, people paid about $152 for an assortment of goods and services that cost $100 during the 1982-1984 base period.

Other price indexes include the *Producer Price Index* and the *Gross Domestic Product Deflator.* The Producer Price Index calculates changes in the prices of regularly used products at various stages of production. The Gross Domestic Product Deflator, also called the *Implicit Price Index* or *Implicit Price Deflator,* measures price changes for everything produced within the country in a certain period.

Kinds of inflation

Mild inflation occurs when the price level increases from 2 to 4 percent a year. If businesses can pass the increases along to consumers, the economy thrives. Jobs are plentiful, and unemployment falls. If wages rise faster than prices, workers have greater purchasing power. But mild inflation usually lasts only a short time. Employers seek larger profits during periods of economic growth, and unions seek higher wages. As a result, prices rise even further—and inflation increases.

Moderate inflation results when the annual rate of inflation ranges from 5 to 9 percent. During a period of moderate inflation, prices increase more quickly than wages, and so purchasing power declines. Most people purchase more at such times because they would rather have goods and services than money that is declining in value. This increased demand for goods and services causes prices to rise even further.

Severe inflation occurs when the annual rate of inflation is 10 percent or higher. This type of inflation is also called *double-digit inflation.* During a period of severe inflation, prices rise much faster than wages, and so purchasing power decreases rapidly.

When inflation is severe, debtors benefit at the expense of lenders. If prices increase during the period of a loan, the debtor repays the debt with dollars less valuable than those that were borrowed. In terms of purchasing power, the lender does not get back as much money as was lent.

Severe inflation also affects a nation's *balance of payments,* the total receipts and expenditures resulting from foreign transactions (see Balance of payments). A nation with severe inflation may find that its products become more expensive for other countries to buy. Therefore, the demand for its exports decreases. At the same time, foreign goods become cheaper for the nation's people, and so they import more. The result could be a *deficit* in the nation's balance of payments. A deficit is the condition that results when expenditures exceed receipts. The deficit, in turn, causes a decline in the nation's *exchange rate,* the price of its currency compared with the currencies of other countries.

Hyperinflation is rapid, uncontrolled inflation that destroys a nation's economy. Money loses its value, and many people exchange goods and services instead of using currency. Hyperinflation occurs when a government spends much more money than it receives in taxes. The government then borrows or prints additional money to pay for the goods and services it needs. The increased demand for these items causes an overall increase in prices. The government then may have to print even more money to pay its expenses. The vast amount of money in circulation causes its value to drop sharply.

Hyperinflation has ruined the economies of some nations during or after wars. It caused the collapse of the German economy after World War I ended in 1918. The German government printed large amounts of currency to finance itself after the war. As a result, prices in Germany increased more than 1 trillion percent from August 1922 to November 1923. In 1923, $1 in U.S. currency was worth over 4 trillion marks.

Effects of severe inflation

Mild inflation, according to some economists, encourages the growth of a nation's economy. Hyperinflation hurts a nation in many ways, but such uncontrolled inflation rarely occurs. Moderate inflation causes some changes in consumer buying habits, and its economic effects increase if the inflation becomes severe.

Effects on consumer behavior. Consumer behavior changes during a period of severe inflation. Many people feel discouraged because their income cannot keep up with rising prices. They cannot plan for future expenses because they do not know how much their money will buy at any later time.

Some people buy more than usual during an infla-

Internationale Bilderagentur

Hyperinflation is rapid, uncontrolled inflation. It causes money to drop sharply in value and thus ruins a nation's economy. After hyperinflation struck Germany during the early 1920's, shoppers needed baskets of currency to buy groceries.

tionary period. Many borrow money or use credit for large expenses, rather than buying later when prices will probably have risen even further.

Some consumers fight the effects of inflation by bartering their services, doing their own home repairs, and making their own clothes. Shoppers may save money by avoiding luxuries and growing their own vegetables.

Effects on income. Severe inflation greatly affects people whose incomes do not increase at the same rate as inflation. Most pensions and other retirement benefits are *fixed*—that is, they neither increase nor decrease. Some benefits, such as U.S. Social Security benefits, are adjusted according to changes in price indexes. As the price level rises, money paid to people receiving these benefits also increases. This adjustment is known as *indexing* or *indexation.*

Indexation is also used to adjust interest rates, taxes, and wages and certain other earnings to correspond with the rate of inflation. Many union contracts provide automatic wage increases based on the inflation rate.

Effects on investment. Some people try to protect themselves against inflation by investing in items that quickly increase in value. Such items include art objects, diamonds, gold bars, rare stamps, and gold and silver coins. Many people buy real estate during inflationary periods because the value of buildings and land increases rapidly at such times.

Effects on business. Some businesses prosper during periods of inflation. They include credit-card agencies, discount stores, and agencies that collect overdue debts. Businesses that lease such items as cars and large appliances, which many people cannot afford to buy, also thrive at these times.

Theories about the causes of inflation

Economists have various theories that attempt to explain why inflation occurs. Many factors contribute to inflation. One element that is almost always present is an increase in a nation's money supply, which either causes or eases the increase in prices.

Inflation occurs during many wars and periods of reconstruction that follow wars. At such times, a nation's economy operates at full capacity, and the demand for goods and services exceeds the supply. This situation causes prices to increase.

The quantity theory says inflation results when the demand for goods and services exceeds the supply. This situation occurs because the money supply rises faster than the rate at which goods and services are produced. Increased demand causes prices to increase, resulting in what is known as *demand-pull inflation.*

The Keynesian theory, developed by the British economist John Maynard Keynes, also focuses on excess demand as the cause of inflation. Keynes believed that increased demand for goods and services should be met by expanded production. However, after a nation's economy reaches full capacity, production cannot expand. If the demand for goods and services increases, prices continue to rise and inflation occurs. In such cases, Keynes recommended a tax increase, which would reduce the demand for goods and services and relieve the pressure on prices.

The cost-push theory. When businesses raise their prices in response to cost increases, *cost-push inflation* results. Workers then may want higher wages to keep up with rising prices, and a *wage-price spiral* occurs.

Cost-push inflation also occurs if a limited number of businesses control the supply of certain products. A *monopoly* exists if one business controls an entire industry. In an *oligopoly,* so few companies provide a product or service that each of the firms can influence the price—with or without an agreement among them. In such controlled industries, consumers must buy from a limited number of sellers at prices set by the controlling firms. But if competition is intense, each firm tries to offer a better or cheaper product than the others.

In addition, cost-push inflation results if several firms form a *cartel,* a group of businesses that functions as a monopoly. A cartel may limit the supply of a product, such as oil or copper, to drive prices up and thus earn higher profits. If the product sold by the cartel is used to make other goods, the cost of those items will also rise.

The expectations theory is based on the belief that prices will increase. When prices rise at a certain rate, people expect them to keep going up at that rate or faster. Many workers try to keep ahead of the expected increases by demanding higher wages. The higher wages, if received, also contribute to rising prices.

Weapons against inflation

Fiscal policy of a nation is reflected by the government's spending and taxing programs. The government can use these programs to reduce the demand for goods and services. It can accomplish this goal by reducing its own spending. If the government buys less from businesses, sales go down and people have less money to spend. The government can also reduce the spendable income of consumers by raising taxes. If consumers spend less money, the demand for goods and services decreases—and prices level off.

Many people object to fiscal policy as a means of controlling inflation. They oppose a reduction in government spending because the funds involved help provide education, health care, and other services. No one wants to pay higher taxes, and a sharp reduction in demand often increases unemployment.

Monetary policy is the program a nation follows to influence such economic factors as interest rates, the availability of loans, and the money supply. The monetary policy of the United States is controlled by the Federal Reserve System, an independent agency of the government. Most large U.S. commercial banks belong to the system. The Federal Reserve determines the amount of money that most deposit-taking institutions must have in their vaults or as deposits at Federal Reserve Banks. This amount is called a *reserve requirement.*

The Federal Reserve can try to reduce the rate of inflation by increasing interest rates. People take out fewer loans at higher interest rates and thus have less money to spend. As a result, the demand for goods and services decreases, and prices rise more slowly. When the Federal Reserve raises interest rates, it is said to be following a *tight monetary policy.* It also may reduce interest rates to follow an *easy monetary policy.*

One way the Federal Reserve can increase interest rates is by raising its reserve requirement. This limits the amount of money banks have available for loans, and so the banks raise their interest rates to ration their loan

funds. If the Federal Reserve wants to reduce interest rates, it lowers its reserve requirement.

The Federal Reserve also may increase interest rates by selling government bonds. Buyers pay for the bonds with checks drawn on their banks. After banks pay these checks, they have less money available for loans, so they raise their interest rates. The Federal Reserve can reduce interest rates by buying back government bonds.

The Federal Reserve also influences interest rates through the discount rate. This is the rate that banks must pay when they borrow money from Federal Reserve Banks. During inflationary periods, the Federal Reserve increases the discount rate. Banks may respond to this increase by charging higher interest rates to their customers. If the Federal Reserve reduces the discount rate, banks may lower their interest rates. Though banks rarely borrow directly from the Federal Reserve Banks, the Federal Reserve uses changes in the discount rate to communicate changes in its monetary policy.

Wage and price controls are established by a government to limit wage and price increases during an inflationary period. When a wage-price spiral occurs, wages and prices increase continually to keep up with each other. Some economists believe that if a government limits these increases, wages and prices will eventually level off. Many other economists consider wage and price controls ineffective because such limits are difficult to establish and hard to enforce. Others believe wage and price controls interfere with the natural rise and fall of wages and prices. Rodney J. Morrison

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Mortgage
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Price control
Supply and demand
Unemployment (Fighting unemployment)
Wages and hours (Wages)

Additional resources

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Inflection is a set of word forms that show different functions or meanings in a sentence. For example, *actors* is an inflected form of *actor.* The *s* added to *actor* expresses the meaning *more than one.* But *actress* is not an inflected form of *actor*—it is a different word. In English, nouns, pronouns, verbs, adjectives, and adverbs are inflected.

The set of inflections of a noun is called *declension.* The written declension of an English noun shows four forms: *man, boy* (common case singular), *men, boys* (common case plural), *man's, boy's* (possessive singular), *men's, boys'* (possessive plural). The declension of some pronouns is more complicated. In addition to a possessive form (*my* or *mine, his*), they have a *nominative* (subject) form (*I, he*) and an *objective* (object) form (*me, him*).

The set of inflections of a verb is called *conjugation.* Some English verbs have five different forms, as in *drive, drives, drove, driven,* and *driving. Drives* is the form used with a singular third person subject. *Drove* and *driven* have tense, or time, meanings. *Driving* is the form used in modifying and to express a continuing action.

The inflection of adjectives and adverbs is called *comparison.* An example of comparison is *fast, faster,* and *fastest.* Marianne Cooley

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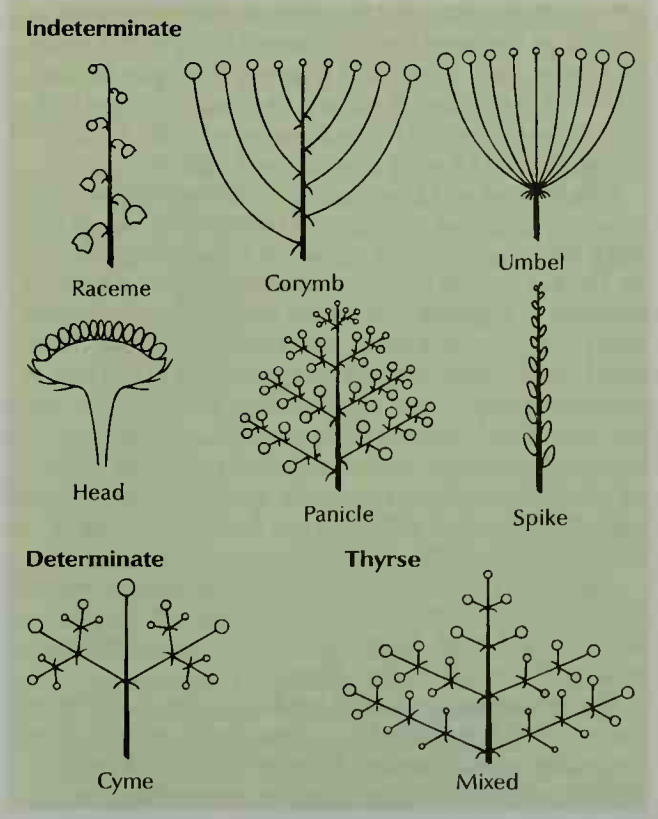
Inflorescence, *IHN flaw REHS uhns,* is the flowering region of a plant. Most botanists use this term only for a group of flowers. The single flower of such plants as the tulip and wake-robin is not classed as an inflorescence. In addition, flowers that grow singly at the bases of normal leaves, such as those of the pimpernel and morning-glory, are not considered inflorescences. Flowers in an inflorescence may be associated with modified leaves called *bracts.* In some plants, such as the flowering dogwood and the poinsettia, the bracts are larger and more noticeable than the flowers.

The two main kinds of inflorescences are indeterminate and determinate. In the *indeterminate inflorescence,* buds are produced and flower from the bottom to the top of the stem. Thus, the lower flowers on the stem are older than the upper ones. In another type of indeterminate inflorescence, the *flat-topped inflorescence,* all the flowers are at about the same level. In this type, the outer flowers are older than the inner ones.

Some examples of indeterminate inflorescences are the raceme, corymb, umbel, head, panicle, and spike. In a *raceme,* each flower is on a short stalk called a *pedicel.* The lily of the valley and the snapdragon have racemes. *Corymbs,* such as on the bridal wreath, are flat-topped clusters of flowers. The outer flowers have longer

Kinds of inflorescences



pedicels than the inner flowers. The *umbel* also is flat-topped, and its pedicels are all attached at the same point. Carrot and dill plants have umbels. Plants with *heads,* such as the thistle and sunflower, have many small, nonpediceled flowers packed on the expanded top of the stem. The *panicle* is like the raceme except the pedicels branch, as in oats and many grasses. *Spikes* are like racemes, except the flowers lack pedicels.

In the *determinate inflorescence,* or *cyme,* the bud at the stem tip develops into a flower, stopping the stem's growth. More flowers can develop only on side branches. The central flower of each inflorescence is the oldest.

A third kind of inflorescence is the *thyrse.* This is a mixed arrangement, with the main stem indeterminate and the side branches determinate. The lilac is an example of this kind of arrangement. Joseph E. Armstrong

See also Raceme.

Influenza is an infectious disease caused by the influenza virus. The disease is commonly called *flu* or *grippe.* The word *influenza* is sometimes used to refer generally to either influenza or similar illnesses.

The symptoms of influenza include chills, fever, headache, aches, and weakness. The symptoms usually disappear in about a week. The patient's resistance may be lowered, so that secondary infections, such as bacterial pneumonia, follow the influenza.

How influenza spreads. Influenza is mainly a respiratory disease. The virus is inhaled and comes in contact with cells of the upper air passages. It penetrates the cells that line these passages and reproduces. In time, new viruses are released from the infected cells and infect other cells along the respiratory tract. Influenza may spread deep within the lungs. The virus may also be carried away in exhaled air and infect other people.

People develop immunity or resistance to influenza when the body produces substances called *antibodies,* which can attach themselves to influenza viruses and prevent them from infecting cells. But the virus may change its chemical composition so that the antibodies no longer work. New kinds of antibodies must be produced by the cells of the body. The body also can make cells called *cytotoxic T cells,* also called *killer T cells,* that recognize and kill cells infected with influenza virus.

Prevention and treatment. Health authorities try to prevent the spread of influenza by means of vaccination. Most influenza vaccines consist of killed influenza viruses. These vaccines offer some protection but are not as effective as scientists would like them to be. During the mid-1970's, vaccines made with live viruses were developed and became available in some parts of the world. Scientists believe such vaccines may offer better protection than killed virus vaccines do. Also, genetic engineering techniques are being used to produce better vaccines. In addition to vaccines, antiviral drugs, such as *amantadine* and *rimantadine,* can be used to treat or prevent certain types of influenza.

Treatment of patients may include combating secondary infections, which cause most of the deaths associated with influenza. Physicians control these infections with antibiotics and other drugs.

Flu epidemics. Influenza tends to occur in epidemics. Each outbreak is caused by a virus slightly different from the earlier ones. Scientists often name the different *strains* (types) of the virus after the place where the strain was first identified. For example, Asian flu was first identified in Asia and later spread throughout the world.

Cold weather does not directly cause influenza, as many people believe. However, influenza outbreaks do occur most frequently in winter in temperate zones. These outbreaks may be related to the crowding of people indoors in cold weather. In such crowded situations, the virus has a greater chance than usual to spread.

One of the worst global epidemics of influenza occurred in 1918-1919. About 20 million people, including more than 500,000 Americans, died in this epidemic. In 1957-1958, Asian flu caused a worldwide epidemic, as did Hong Kong flu in 1968-1969. Far fewer deaths resulted from these epidemics, due largely to the control of secondary infections with antibiotics.

There are three main types of influenza viruses: *type A, type B,* and *type C.* Types B and C appear to infect only human beings. Type A can infect people and certain animals, such as swine. The animals may then carry and transmit the infection. Epidemics may be caused by type A or type B. Outbreaks of influenza involving both types A and B also have occurred. Robert E. Marquis

Information Agency, United States. See United States Information Agency.

Information retrieval is a branch of computer and information science that develops systems to help people find the information they need. Information retrieval has become especially important since the 1990's, when the World Wide Web began to greatly increase the amount of information available to computer users.

The World Wide Web (often called the Web for short) is a system of interconnected computer files from all over the world linked to one another on the Internet. Many of these computer files include *multimedia* data—that is, sounds, pictures, and moving images, as well as text. The vast amounts of text and multimedia data available on the Web far exceed the management capabilities of manual organization systems. Web search engines are a type of information retrieval system that is familiar to many people. But other systems are used for applications in business, government, and education that involve large text databases. In contrast to an information retrieval system, a database management system deals with data organized in highly structured tables.

How information retrieval works. The main functions of an information retrieval system are (1) indexing, (2) formulating queries, and (3) ranking. Indexing is the creation of an organized guide to the contents of a file, document, or group of documents. In the case of a Web search engine, indexing involves extracting representative words and phrases from the contents of Web pages. The extracted words and phrases are stored in an index structure designed to make searching millions of pages very fast. Web indexing also involves *Web crawling,* also called *spidering,* a process of discovering new pages by following *links* (interactive connections).

Most queries in Web search engines are just lists of words. But a user can often specify more complicated queries by adding *Boolean operators*—connecting words such as *and, or,* or *not.*

In the ranking function, the search engine uses the index structure to compare queries and Web page contents. A retrieval *algorithm* (mathematical process) calculates a score for each Web page that has matching

words and phrases. The score is based on such information as the number and frequency of matching words, the number of links pointing to a page, and where matches occur in a page. The search engine displays a summary of the pages with the highest scores.

Research. Researchers in information retrieval constantly seek ways to improve the ability of the systems to identify relevant information. The goal of *question answering* is to provide specific answers to questions by extracting sentences containing answers from text. In addition to traditional ranking techniques, a question-answering approach must involve *natural language processing*, which helps computers respond to questions phrased in ordinary language.

Many search engines make use of *directories,* categories of information that people have created. Researchers are working on techniques to produce directories automatically. Other important research areas involve developing programs that summarize text content automatically and designing systems to deal with text in multiple languages.

A technique called *filtering* involves creating profiles of people's interests or preferences, and comparing those profiles to information from newswires, product announcements, or other sources. A service can then alert people to information of particular interest.

History. People began to use computers for information retrieval in the 1960's, but manual systems for information retrieval date to ancient times. In the 200's B.C., the Greek scholar Callimachus developed a catalog for the Alexandrian Library in Alexandria, Egypt. The catalog classified the library's writings into the works of poets, lawmakers, philosophers, historians, orators, and miscellaneous writers. During the Middle Ages, monks developed *concordances* for the Bible, lists of the holy book's principal words with references to the passages where they occurred. In 1876, the American librarian Melvil Dewey developed the widely used Dewey Decimal Classification system for organizing library materials. W. Bruce Croft

See also Database; Index; Information science.

Information science is the study of the recording, storage, retrieval, and use of information. Many librarians study information science. It is also used by businesses and government agencies.

Information science deals with a variety of issues. For example, some information scientists specialize in *information technology,* the application of computers and techniques of using computers to handle data. They may seek ways in which people can more easily ask questions of a computer and then view and understand the computer's answers. Such studies have aided in the design and improvement of the computerized catalogs used by patrons of modern libraries.

In addition, information science includes the study of *bibliometrics.* Bibliometrics measures the increase or decrease in the number of books on a particular topic, the rise or fall in the usage of books in a given category, and the extent to which the aging of information affects its usage. For example, information scientists might compare the number of books a library has about dinosaurs with the frequency with which such books are used by the library's patrons. In this way, information scientists can determine whether the number of dinosaur books owned by the library meets the needs of patrons.

Information scientists also seek better ways to manage information systems. Management issues studied by information scientists include how to reduce the cost of maintaining an information system, how the characteristics of a system affect the decisions of its users, and how a particular kind of information can be best marketed as a product. Donald H. Kraft

See also Database; Information retrieval; Information theory; Library (Information science and technology).

Information superhighway. See Internet.

Information theory describes how messages are transmitted and received through such electronic information systems as radio, the telephone, and television. It provides mathematical laws to determine the probability that all the individual parts of a message, called *bits,* will be transmitted without distortion. Electronics engineers use these laws to improve the capacity, efficiency, and clarity of information systems. The practical application of these laws is often called *information science.* Although information theory most often refers to the study of electronic communication networks, other disciplines have begun to use its methods and ideas. For example, sociologists, psychologists, educators, and business managers have used information theory to learn more about how people communicate. Librarians have also worked to improve their methods of information collection, organization, and retrieval through the use of information theory. David McComb

See also Cybernetics.

Infrared rays, *ihn fruh REHD,* also called *heat rays* or *thermal radiation,* are a form of energy that resembles visible light, but cannot be seen by the human eye. Any warm object, such as an object at room temperature, *emits* (gives off) infrared rays due to its heat. If the temperature is increased, the object will emit more infrared rays. If the temperature becomes very high, the object will glow with rays of visible light as well as infrared rays. For example, an ordinary light bulb's *filament* (thin, coiled wire) glows with both kinds of rays when its temperature rises to more than 4500 °F (2500 °C).

Human beings and other warm-blooded creatures emit more thermal radiation than their surroundings and therefore glow brightly with infrared rays. Police use special cameras that can detect infrared rays to locate people in dark or foggy areas. Firefighters use such cameras to find people in smoke-filled rooms.

Military applications include the detection of heat exhaust from tanks and aircraft at night. Astronomers use infrared cameras to search for the heat from newborn stars hidden inside clouds of gas and dust. Remote controls for television sets use infrared rays.

Infrared rays, like rays of light and radio waves, are electromagnetic waves. All these waves travel in a vacuum at the same speed, 186,282 miles (299,792 kilometers) per second. What distinguishes them from one another is their *wavelength* (distance between successive wave crests). The wavelengths of infrared rays are longer than those of light and shorter than those of radio waves. Infrared wavelengths range from about 700 nanometers to 1 millimeter. One nanometer is one-billionth of a meter, and 1 millimeter is one-thousandth of a meter.

British astronomer Sir William Herschel discovered infrared rays in 1800. He used a prism to break up light

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An infrared photograph shows heat escaping from inside a house and radiating from its surfaces. Areas that show in yellow and red are the warmest. Green and black areas are the coolest.

from the sun. The prism spread out the different colors of sunlight into a band called a *spectrum.* At one end of the spectrum was violet light, which has the shortest wavelengths. At the other end was red light, with the longest wavelengths. Herschel then used a thermometer to measure heating effects at different parts of the spectrum—and beyond. He found a strong heating effect beyond the red end of the spectrum. He concluded that invisible rays were producing this effect. Infrared rays get their name from their location on the electromagnetic spectrum. The prefix *infra-* means *below.*

Ian S. McLean

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Bolometer	Light (The nature of light)	Thermography
Electromagnetic waves	Night vision systems	
	Remote control	

Ingalls, *IHNG guhlz,* **John James** (1833-1900), was an American editor, lawyer, and statesman. He became a Republican United States senator from Kansas in 1873, and served for 18 years. Ingalls, though not a prominent statesman, was an effective writer and orator, and excelled in descriptive writing.

Ingalls was born in Middleton, Massachusetts, and graduated from Williams College in 1855. He moved to Atchison, Kansas, in 1858. Ingalls represents Kansas in Statuary Hall in the Capitol in Washington, D.C.

Inge, *ihnj,* **William** (1913-1973), was an American playwright. His best plays are realistic psychological studies of ordinary people in small Midwestern towns. They show that deep feelings of hope, fear, or desire can lie below the surface of quiet lives and block individual fulfillment until the frustrations are brought to the surface.

Come Back, Little Sheba (1950) sympathetically examines the unfortunate lives of an alcoholic chiropractor and his wife. The couple's weaknesses feed upon each other until the two people finally learn to face them. *Picnic* (1953) shows how the repressed romantic dreams of several women are brought to a crisis when a handsome wanderer comes to town. The play won a Pulitzer Prize. In *Bus Stop* (1955), Inge treated in a lighter manner the dreams and yearnings of a group of people in a highway diner. *The Dark at the Top of the Stairs* (1957) centers on the loneliness of family members who cannot communicate with each other. Inge was born in Independence, Kansas.

Thomas P. Adler

Ingersoll, *IHNG gur sawl,* **Jared,** *JAIR ehd* (1749-1822), was a Pennsylvania signer of the Constitution of the United States in 1787. Ingersoll held many state and national offices during a long career in public service.

Ingersoll was born in New Haven, Connecticut. He graduated from Yale College in 1766 and became a distinguished lawyer in Philadelphia. His father, Jared Ingersoll, Sr., remained loyal to Britain during the Revolutionary War in America (1775-1783), but the younger Ingersoll joined the patriots' cause. Ingersoll served in the Second Continental Congress in 1780 and became known as a supporter of a more vigorous national government. He was attorney general of Pennsylvania from 1790 to 1799 and again from 1811 to 1817. In the 1790's, he argued cases before the Supreme Court of the United States and helped define several complex constitutional issues.

Richard D. Brown

Ingersoll, *IHNG gur sawl,* **Robert Green** (1833-1899), was an American lawyer, politician, lecturer, and writer. He was a center of controversy for almost 30 years because he attacked traditional Christian beliefs. He lectured on his creed of agnosticism, the belief that the existence of God cannot be known with certainty. His best-known lectures included "Some Mistakes of Moses" (1879), "Why I Am an Agnostic" (1896), and "Superstition" (1898).

Ingersoll was born in Dresden, New York. As a boy, he moved with his family to Ohio, to Wisconsin, and then to Illinois. He studied law with his older brother and was admitted to the bar in Illinois in 1854.

Ingersoll served as a colonel in the 11th Illinois Cavalry during the American Civil War (1861-1865). He had entered politics as a Democrat but became a prominent Republican after the Civil War. He won fame for a speech proposing James G. Blaine as the presidential nominee at the 1876 Republican National Convention.

Ingold, Sir Christopher (1893-1970), an English chemist, made fundamental contributions to the field of *organic chemistry,* the study of compounds that contain carbon atoms. Often in collaboration with his chemist wife, Edith Hilda Usherwood, he investigated the electric charges present in organic compounds and developed theories on the part these charges play in chemical reactions. He and the Welsh chemist Edward David Hughes carried out detailed studies of *elimination reactions,* in which molecules lose a portion of their structure, and *substitution reactions,* in which one subunit of a molecule is replaced by a different one.

Christopher Kelk Ingold was born in London. He received a doctor of science degree from the University of London in 1921. In 1930, he was appointed professor of chemistry at University College, University of London. In 1952, he received the Royal Medal from the Royal Society, one of the world's foremost scientific societies. He was knighted in 1958.

Melvyn C. Usselman

See also Organic chemistry.

Ingres, *AN gruh,* **Jean Auguste Dominique,** *zhahn oh GOOST daw mee NEEK* (1780-1867), was a leading French artist who painted in the style known as neoclassicism. Ingres painted many historical, mythological,

and religious subjects. However, he is probably most admired for his portraits and female nudes. Ingres's style emphasizes orderly compositions, smoothly painted surfaces, and precise drawing. Ingres ranks among the finest draftsmen in the history of painting.

Although Ingres is identified with neoclassicism, he painted in a variety of styles. For example, his painting *The Dream of Ossian* resembles works painted in the romantic style because of the way it presents its theme. Several of Ingres's works reflect the influence of one of his favorite artists, Italian Renaissance painter Raphael.

Ingres was born in Montauban. He studied in Paris with the famous neoclassical artist Jacques Louis David for four years. Ingres then studied and worked in Italy from 1806 to 1824. His altarpiece *The Vow of Louis XIII* gained Ingres his first acclaim when it was exhibited in Paris in 1824. From 1835 to 1841, Ingres directed the French Academy, an art school in Rome supported by the French government. Richard Shiff

See also **Painting** (Later neoclassicism; picture: *Comtesse d'Haussonville*); **Drawing** (picture).

Inhalant is a breathable chemical vapor that produces mind-altering effects. The use of inhalants is one of the most serious types of drug abuse in young people. Children as young as 6 to 8 years of age have abused inhalants. Doctors think that the highest rate of abuse occurs among teen-agers 14 or 15 years old.

Experts estimate that more than 1,000 substances emit vapors that can be abused as inhalants, including certain types of glues, paint thinners, and cleaning agents. Many inhalants are commercial products designed for removing or dissolving fats and oils. After their vapors are inhaled, these fat-dissolving chemicals reach the brain. A fatty substance naturally coats many of the brain's billions of nerve cells. Inhalants attack these fatty parts of nerve cells in much the same way as they remove grease and oil. As a result, abusers risk serious brain damage.

Inhalant abusers—including first-time users—also risk heart failure and sudden death. Doctors think inhalants can cause sudden death by making the heart muscle especially sensitive to a hormone called *epinephrine*. If abusers are startled while using inhalants, the body's release of epinephrine can cause a deadly irregular heartbeat. Other dangers of inhalants may include suffocation, hearing loss, and damage to nerves and *bone marrow* (blood-forming tissue). David F. Musto

See also **Drug abuse**.

Inheritance, in biology. See **Heredity**.

Inheritance tax is paid on property passed on from a deceased person to those who are to inherit it. The term may be applied to two different taxes: (1) a tax on the total property before it is divided, and (2) a tax on each of the distributed portions after they have been given to the heirs. Technically, these two taxes should be called *estate taxes* and *inheritance taxes,* respectively. The United States government levies only an estate tax. Some state governments levy both inheritance and estate taxes. In 2001, the United States passed legislation to reduce the federal estate tax and to eliminate it completely in 2010.

Federal estate tax rates are based on the Economic Recovery Tax Act of 1981. This law was designed so that no tax is paid on the average family's estate. In 1997, no tax was due on most estates under $600,000. The maximum rate of 55 percent generally applies to estates in excess of $3 million.

An unlimited amount of an estate can be transferred to a spouse at death without being taxed. A credit is granted on federal estate taxes for state death taxes paid. The credit is subtracted from the amount of tax otherwise owed. Some people give property away before they die so that less inheritance and estate taxes will have to be paid. However, the federal government and a number of states levy a *gift tax* on property given away during the donor's lifetime.

The United States raised money from an estate tax between 1898 and 1902. The modern estate tax law was passed in 1916. The gift tax was introduced in 1932. Later laws have modified these taxes.

In Canada, only the province of Quebec levies an inheritance tax. Canada has no estate taxes.

Joseph J. Cordes

Inis is the Irish word for *island.* The word occurs in many place names along the western coast of Scotland and the shores of Ireland. *Inish,* the Anglicized form of the word, also occurs in Irish place names.

Initial public offering (IPO) refers to the first-time sale of a company's stock to the public. An IPO marks the beginning of a company's trading on a stock market. Because an IPO transfers a company's ownership to public investors, the company is said to have "gone public."

When a firm decides to go public, it typically hires an investment bank to help with the process. The bank offers advice, assists in preparing a *prospectus* (printed statement) describing the company and the offering, and markets and distributes the shares to investors. Government regulators, such as the Securities and Exchange Commission in the United States, must approve the terms of the IPO. A company can use the money raised through its IPO to pay debts, to expand business operations, or both.

Companies going public attract much attention because many IPO's rapidly increase in value once trading begins. Such IPO's may be risky, however. In the 1990's, for instance, many technology companies went public, and investors enthusiastically bought shares in them. But in the early 2000's, many of these companies went bankrupt after spending the money raised by their IPO's.

Jay R. Ritter

See also **Investment; Stock, Capital; Stock exchange.**

Initiative and referendum are actions that allow the voters of a city, state, or country a certain amount of direct control over lawmaking. Through the *initiative,* the voters can introduce a law. Through the *referendum,* a proposed law is submitted to the people for approval. When the expression *initiative and referendum* is used, it refers to a process in which the voters both introduce a law and vote on it.

Both initiative and referendum enable the people to take direct political action if their representatives refuse to pass some legislation that the people want. Only a tiny fraction of state and local laws have been passed by initiative and referendum, which are too costly and difficult to take the place of a lawmaking body.

The initiative. In cities, states, or countries that use the initiative, anyone may draw up a proposed law. If a

specified number of voters sign a petition favoring it, the proposed law goes either to the voters or to the lawmaking body, which must vote on it.

The initiative is useful in cases where lawmakers refuse to enact, or even to consider, a law that the people want. However, the initiative has been criticized as a means of allowing a minority group to promote its special interests.

Laws providing for the initiative vary greatly. In some states, the whole question is ended if the legislature votes the bill down. In other states, the bill is then submitted to the people. If they vote for it, the bill becomes law. This procedure is called the *indirect initiative.* The governor cannot veto a bill passed in this way. Some states submit the proposed law directly to the people without bringing it before the legislature. This method is called the *direct initiative.* The initiative works in much the same way in a city as it does in a state. The city council, the city commissioners, or the people must pass on the proposed law, and the mayor cannot veto it.

The referendum puts a proposed law on the ballot at the next general election or at a special election. Most city charters and state constitutions provide for the referendum. For example, nearly all states hold a *constitutional referendum* on proposed amendments to their constitution. A constitutional referendum gives voters an opportunity to approve or reject the amendment. A large number of cities and states also hold a *statutory referendum,* which allows citizens to vote on laws passed by the legislature or proposed by an initiative. There are three kinds of statutory referendums: (1) *compulsory referendum,* (2) *optional referendum,* and (3) *referendum by petition.*

A compulsory referendum requires that the city or state submit certain kinds of measures to a vote by the people. Such kinds of measures may include proposals to issue municipal bonds, to raise property taxes for local schools, or to change the boundaries of a city.

An optional referendum permits the legislature to submit controversial measures to a direct vote of the people. The results of the referendum may be binding, or the legislature may use the referendum only to learn the people's opinion on an issue.

A referendum by petition takes place when a required number of citizens demand that a bill be submitted to a vote. For such a referendum to be held, the law must specify a waiting period, in most cases 90 days, before a bill takes effect. The required number of voters must sign a petition objecting to the bill during that period. Most states hold a referendum if 5 or 10 percent of the voters request it.

History. The initiative has been known only recently, but the referendum has been used for hundreds of years. Two cantons, or states, of Switzerland have had the referendum since the 1500's. Australia and New Zealand adopted the initiative and referendum in 1901.

The movement for initiative and referendum in the United States grew in the late 1800's and early 1900's. In 1898, South Dakota became the first state to adopt initiative and referendum laws. The initiative and referendum were included in the Oregon Constitution in 1902.

The combined power of initiative and referendum is provided by laws in many cities and in about half the states. Most other states provide for use of the referendum. The laws often include an additional provision called the *recall.* This is a method of removing officials from office by vote of the people (see **Recall**). The use of referendums in the United States increased in the late 1900's. Subjects covered included attempts to limit tax increases, the death penalty, nuclear power, handgun use, and the growth of cities.

The United Kingdom has no provision for the initiative and referendum as such, but the principle of the referendum is a regular part of the British election system (see **Cabinet**). In Canada, the initiative and referendum have been discussed, but no steps have been taken to provide for them by law. Robert Agranoff

Injection. See **Fuel injection; Hypodermic injection; Intravenous injection.**

Injunction is an order requiring a person or group of people to do, or not to do, something. A court issues an injunction only when it finds that money alone could not pay for damage done or about to be done.

Here are two examples of cases where an injunction might be used: (1) If someone is imitating a trademark, the owner of the trademark could appeal to a court for an injunction ordering the other person to stop imitating it. (2) If someone plans to change the course of a stream which waters a farmer's fields, the farmer could appeal to a court for an injunction ordering that person not to divert the stream. In these cases, money would not restore the full value of the trademark, or repay the farmer for the loss of a stream.

An order *not to do* an act is called simply an *injunction.* An order *to do* an act is called a *mandatory injunction.* If the court must act swiftly, it may issue a *temporary injunction* until it can hear the case. After it hears the case, the court may make the injunction a *permanent* one or it may *dissolve* the temporary injunction and refuse any further orders in the case. Injunctions have been used to stop labor strikes. However, a federal statute, and some state laws, prohibit the use of an injunction to stop a strike except in grave emergencies.

James O. Finckenauer

See also **Labor movement** (Opposition to unions).

Injury. See **First aid; Blister; Bruise; Burn; Sprain; Safety; Whiplash.**

Ink is a colored liquid, powder, or paste used for writing, drawing, or printing. There are thousands of kinds of inks, many of which are used for printing newspapers, magazines, and cartons and other packaging, or for writing with ballpoint pens and fountain pens. The printing industry uses more ink and more kinds of ink than any other industry.

Most inks consist of a *colorant* and a liquid or paste *vehicle.* The colorant provides the ink's color. Colorants are made from dyes, which dissolve completely in the vehicle, or from pigments, which remain suspended in the vehicle. Among the most widely used pigments are black pigments called *carbon blacks.* Carbon blacks are made from the soot that is produced by burning petroleum or similar fuels in limited supplies of air. Other commonly used dyes and pigments include phthalocyanine (blue or green), ultramarine (blue), iron oxide (red), lead chromate (yellow or orange), and titanium dioxide (white).

The vehicle carries the colorant and helps bind it to the paper or other material. Vehicles consist of colorless

solids or semisolids called *resins* dissolved in liquids called *solvents*. Most of the resins used in inks are synthetic substances. Alcohol, petroleum, and water are popular solvents. Oils used as solvents include mineral oils and such vegetable oils as tung or linseed oil.

Writing inks include those used in ballpoint pens, fountain pens, and special pens used by artists. Most writing inks consist of dyes and resins dissolved in a solvent that has little odor. The most commonly used solvents are water and *glycols* or similar alcohols. Most writing inks dry when the solvent has evaporated and the paper has absorbed the colorant and resins.

Different kinds of pens use different kinds of inks. For example, ballpoint pens use a thick, sticky ink. This ink is designed so that it does not leak around the tiny, rotating ball that transfers the ink from the pen onto the paper. Certain ballpoint pens use inks that may be easily erased. Such inks contain pigments and, unlike most writing inks, are not readily absorbed by the paper. Instead, the resin at first binds the pigment only to the surface of the paper. The resin and pigment can then be erased without damage to the paper.

Most pens other than ballpoints use highly fluid inks. Ink for a fountain pen, for example, must flow easily through a system of thin tubes leading from the ink reservoir to the *nib* (point). Most fountain pen inks consist of iron compounds mixed with tannic acid in water.

Printing inks generally contain pigments instead of dyes. Vehicles used in printing vary greatly. Printing inks differ depending upon the method of printing. Some printing presses, such as those used to print books and magazines, require thick, sticky inks. Other presses use ink that is much more fluid.

Different printing inks dry by different processes. Some are passed through heated rollers or dryers that evaporate the solvent. Some inks are heated and then chilled to dry in a process called *solidification*. In *absorption,* the vehicle seeps into the paper and leaves the pigment trapped by fibers at the paper's surface. In *oxidation,* resins and oils in an ink react chemically with oxygen in the air to form a solid.

Computer printers also use different types of ink. Most inkjet printers use small, heated droplets of ink to reproduce text and illustrations. The computer instructs nozzles in the printer to spray the proper pattern of ink droplets on the paper. Once the ink reaches the paper, it dries by absorption or evaporation. Laser printers use an electrically charged dry ink powder called *toner*. This type of ink sticks to magnetized areas of a cylinder inside the printer. The ink is transferred to paper, which then passes through heated rollers. The heat causes the ink to adhere permanently to the paper.

History. The ancient Egyptians and Chinese used inks at least as early as the 2500's B.C. They made their inks from various natural materials, such as berries, bark, linseed oil, and soot. Other early inks were made from *galls* (abnormal growths) on oak trees. Through the centuries, thousands of different formulas have been developed for inks. Today, most inks are made from synthetic chemicals. Frank J. Romano

See also Eraser; Inkjet printer; Invisible ink; Pen; Printer (Laser printers).

Inkatha Freedom Party (IFP) is a political party in South Africa. A large number of Inkatha Freedom Party supporters are Zulu-speaking people.

Inkatha was founded in the 1920's to generate mass support for the Zulu monarchy. It developed from an organization called *Inkatha Ye Nkululeko Ye Sizwe* (National Cultural Liberation Movement). After a period of relative inactivity, Inkatha was revived by Zulu Chief Mangosuthu Buthelezi in 1975. Its aims included freeing Africans from white colonialism and ending ethnic discrimination.

In the 1980's, the IFP began a bitter—and sometimes violent—rivalry with the African National Congress (ANC). In 1994, however, the IFP joined the majority ANC in the first South African government chosen by voters of all races. Bruce Fetter

Inkjet printer is a device used to print text and illustrations created using a computer. It uses a high-speed nozzle to spray a thin jet of fast-drying ink onto paper that is fed through the printer. Before spraying the ink, the printer separates it into droplets by heating or vibrating it. The printer responds to instructions from software in the computer. This software instructs the printer to rapidly turn the jet on and off and controls the jet's direction in order to form the desired printed output.

Most inkjet printers can print in either black or full color. To produce a full range of color, printers usually have separate tanks holding black, red, blue, and yellow inks. Some printers use only red, blue, and yellow inks. In such printers, a mixture of the three inks produces black. Most inkjet printers produce the sharpest images when used with special paper. However, inkjet printers can print on a variety of papers, and even on fabric.

Inkjet printers can produce detailed, colorful images, yet they are relatively inexpensive to buy and operate. Thus, many users of home computers own inkjet printers. The printers are also used in business applications and *desktop publishing* (the use of personal computers to design and edit publications). Keith Ferrell

Inland revenue refers to all taxes except those on foreign commerce. Inland revenue is the main source of government funds in most countries. It includes taxes on personal and business income, real estate, manufacturing, inheritances, and sales. These taxes are sometimes called *internal revenue*.

In some countries, the term *inland revenue* appears in the name of the government department that collects some or all of the taxes. In the United Kingdom, for example, the Board of Inland Revenue collects taxes on personal income, corporate earnings, and inheritances. Other countries with similar inland revenue departments include Malaysia, New Zealand, and Singapore.

In the United States, the Internal Revenue Service collects most inland revenue for the federal government. Inland revenue collected by the federal and state governments includes income, inheritance, and *excise* taxes. Excise taxes are those levied on a specific product or service, such as gasoline, tobacco, or liquor. Many states also levy sales taxes. Emil M. Sunley

See also Internal revenue with its list of *Related articles*.

Inland waterway is a canal, river, or lake that may be used by boats, barges, or ships. Inland waterways are chiefly used to transport bulky goods, such as coal, petroleum, sand, and grain, because they can move these goods more economically than railroads or trucks.

United States waterways carry over 600 million tons (540 million metric tons) of domestic freight each year. Most major waterway systems in the United States and Canada are about 9 feet (3 meters) deep.

Most of the traffic on rivers and canals consists of barges. Most barges are from 175 to 290 feet (53 to 88 meters) long, and can carry over 3,000 tons (2,700 metric tons). A large barge can hold as much freight as 50 or more freight cars. Several barges tied together form a *tow* that can be pushed by one tugboat. Tows may include more than 30 barges and may carry as much freight as two or three railroad trains.

Mississippi River System. The Mississippi and Ohio rivers and their *tributaries* (branches) form the busiest inland waterway system in the United States. The system handles over a third of the nation's inland waterway traffic. Most of this traffic moves raw materials, such as petroleum and coal, to industrial centers. Ships can travel over 1,800 miles (2,897 kilometers) on the Mississippi from Minneapolis, Minnesota, to the Gulf of Mexico. Nearly half of the Mississippi traffic consists of large tows of petroleum barges. These barges travel from the Gulf Coast to northern industrial cities, such as Chicago, Cincinnati, and Pittsburgh, by way of the Illinois Waterway or the Ohio. Coal from West Virginia is carried along the Monongahela River to the steel mills of Pittsburgh.

Great Lakes-St. Lawrence Seaway System links the Great Lakes and the Atlantic Ocean. It is vital to the shipping industries of both Canada and the United States. The St. Lawrence Seaway allows oceangoing vessels to sail to Great Lakes ports. Large vessels carry iron ore from Minnesota and eastern Canada to the steel mills of Chicago, Detroit, and the Lake Erie ports. Coal is moved from the Erie ports to Chicago, Detroit, and other lake ports. Grain is shipped from Canada, Minnesota, and Chicago to eastern U.S. and Canadian cities and overseas.

Intracoastal Waterway System. An intracoastal waterway connects ports along a coast. It provides a protected route for pleasure boats and small commercial vessels. In the United States, the Atlantic Intracoastal Waterway and the Gulf Intracoastal Waterway combine to form the Intracoastal Waterway System. This system is a continuous series of connecting bodies of water between Boston, Massachusetts, and Brownsville, Texas. The Gulf section has about 20 times as much freight traffic as the Atlantic section because of the large petroleum industries along the Gulf of Mexico.

Other systems. Among other important U.S. waterways are the Arkansas River Navigation System, the combination of the Tennessee-Tombigbee Waterway with the Black Warrior-Tombigbee-Mobile River System, and the New York State Barge Canal System with the Hudson River. James C. Walters

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Saint Lawrence Seaway

Design from *Sheraton's Cabinet Directory* (1803); the Metropolitan Museum of Art, Purchase Gifts of Mrs. Russell Sage and various other donors, 1969.

Wood inlay decorates a bookcase-desk made in America in 1811. The inlaid sections are ovals of light-brown satinwood set in darker mahogany. Painted glass panels also add decoration.

Inlay is a type of decoration usually created by cutting a design into the surface of one material and filling the pattern with another, often contrasting, material. Inlay is generally associated with the production of wooden furniture. The most common type of inlay has narrow stripes or bands of a light-colored wood set into a darker ground wood, such as mahogany.

Inlay is often confused with *marquetry,* a related technique. In marquetry, a decorative *veneer* (outer layer) of variously shaped wooden pieces is applied over the wooden framework of a piece of furniture. These pieces form a pattern of fanciful designs, flowers, or figures. French cabinetmakers of the 1700's excelled in the arts of inlay and marquetry. In a form of inlay called *mosaic,* small colored pieces of glazed ceramic, glass, or other material are set in a binding material, such as plaster, to form a pattern or picture. John W. Keefe

See also **Mosaic; Furniture** (pictures).

Inness, George (1825-1894), was an American landscape painter. During his long career, Inness painted in a variety of styles. His work ranged from objective, realistic landscapes to deeply personal interpretations of nature.

Inness's early landscapes were carefully composed, detailed works influenced by a group of American landscape artists called the Hudson River School. In 1854, Inness visited France, where he saw the paintings of a group of landscape artists called the Barbizon School. These artists painted in a looser style than the Hudson River School. Under the influence of the Barbizon School, Inness tried to create fresh, direct impressions of nature. One of Inness's finest works in this style is *Peace and Plenty* (1865), a broadly brushed scene of a harvest.

During the 1860's, Inness adopted the mystical religious ideas of the Swedish philosopher Emanuel Swe-

Peace and Plenty (1865), an oil painting on canvas; Metropolitan Museum of Art, Gift of George A. Hearn, 1894

An Inness painting has a feeling of spaciousness and optimism typical of American landscape art in the mid-1800's. The poetic scene emphasizes glowing color and light.

denborg. Instead of painting clear, straightforward landscapes, Inness attempted to express a more spiritual and melancholy attitude toward nature. He painted poetic, misty scenes in which solid objects were reduced to blurred smudges. In *The Coming Storm* (1878) and other works, Inness tried to portray the passing moods of nature and the emotions they aroused.

Inness was born on a farm near Newburgh, N.Y. His son, George Inness, Jr., was also a noted landscape painter. Sarah Burns

Innocence, a flower. See **Bluet**.

Innocent III (1160?-1216) is often considered the greatest of the medieval popes. His most significant contribution to history was the creation of a doctrine of papal authority that has defined the pope's power to this day.

Imperial power. Innocent was elected pope in 1198. At the time of his election, he had to deal with an unstable political situation. The Papal States were in chaos (see **Papal States**). Also, there were two rival claims for the throne of the Holy Roman Empire. Innocent restored papal authority to the Papal States and cleverly played off each imperial candidate against the other. Innocent eventually chose to support Frederick II as emperor in about 1212. Innocent used the dispute to claim that the pope had the right to examine and approve those elected to the imperial throne.

Innocent involved himself in the affairs of France and England. He declared that the pope could judge *secular* (nonreligious) "matters of sin," a broad definition that could include almost any matter. Innocent excommunicated King John of England after John refused to recognize the pope's appointee for archbishop of Canterbury, Stephen Langton. In 1213, John submitted to the pope. He surrendered England and Ireland to the pope and received them back as papal *fiefs* (feudal estates).

Crusades. The crusade was an important element of Innocent's policies. He called for new crusades to liberate Jerusalem from Muslim rule. But the Fourth Crusade (1202-1204) instead conquered Constantinople, the center of eastern Christianity. Innocent hoped that the conquest of Constantinople might lead to the reunification of the Eastern and Western churches, but this reunification failed to occur. In 1208, Innocent launched a crusade against the Albigenses, a radical sect that lived in southern France, and stopped the spread of their heresy.

Spiritual authority. Innocent did much to strengthen papal authority in the church. He reorganized the Roman Curia, the pope's administrative arm, and created an international judicial *tribunal* (court) to hear appeals from throughout the Christian world. He also approved the first official collection of *canons* (church laws). Innocent created a new vision of papal power. He called the pope the "Vicar of Christ," and described the pope as being below God, but above all other people.

Innocent called one of the most important general councils of the Middle Ages, the Fourth Lateran Council, which met in 1215. The council enacted 70 decrees regulating church affairs. Innocent was born in or near Agnani, Italy. His given and family name was Lothar of Segni. Kenneth Pennington

See also **Roman Catholic Church** (Innocent III); **Crusades** (The Fourth Crusade); **Langton, Stephen Cardinal**.

Innocent IV (1200?-1254) was elected pope in 1243. He was preoccupied during most of his reign with the papacy's disputes with the Holy Roman Emperor Frederick II. Innocent fled to France in 1244 because he feared he would be seized by Frederick's troops. In 1245, Innocent excommunicated Frederick and declared Frederick deposed at a council held in Lyons. Frederick died in 1250. In 1251, Innocent triumphantly returned to Italy.

Innocent's struggle with the empire was costly. He concentrated on defeating Frederick and neglected spiritual concerns. Innocent centralized papal authority and introduced practices that would later be considered abuses. His policies were designed to raise money for

the papal armies, and these measures lowered the prestige of the papacy. Innocent was born in Genoa, Italy. His given and family name was Sinibaldo Fieschi.

Kenneth Pennington

Inns of Court was the name given during the early Middle Ages to four groups of buildings in London where lawyers lived, studied, taught, and held court. They are the Inner Temple, the Middle Temple, Lincoln's Inn, and Gray's Inn. All date back to the 1200's. They stand near the Courts of Justice.

In the Middle Ages, young people wishing to study law gathered around famous masters or professors to learn from them. At first, these students lived in the teacher's home. But the number of students became so large that they had to live in inns, rather than in homes. *Inns of Court* came to mean not only the buildings, but also the legal societies that owned and used them.

The four legal societies have great importance today. By long custom, only they can admit barristers to practice their profession before the courts of England. The phrase *admitted to the bar* had its origin in the Inns of Court. Students became full-fledged barristers when they were finally allowed to leave their seat in the outer court and present a case at the wooden rail (*bar*). The judges and approved lawyers sat on the other side of the bar. Basil D. Henning

Innsbruck, *IHNZ bruk* (pop. 118,112), a summer and winter resort, is the capital of the Austrian province of Tyrol. It lies in the Inn Valley in the Alps, 1,985 feet (605 meters) above sea level. For location, see **Austria** (political map). Innsbruck is a rail and marketing center. Its major products include leather, stained glass, textiles, and processed food. It has a university, technical school, botanical garden, and museums. The resort was the home of many Habsburg Tyrolese rulers in the 1300's and 1400's. The 1964 and 1976 Winter Olympics were held in Innsbruck. William J. McGrath

Inoculation, *ih NAHK yuh LAY shuhn,* is the injection of a special preparation into the body in order to produce immunity. The preparation stimulates the body's immune system against a particular disease-causing agent. It may be made from specially treated *toxins* (poisons), or from disease-producing bacteria or viruses. The term *inoculation* is also commonly used for the injection of other materials, such as serum or gamma globulin, into the body. Inoculation has been used since ancient times in China, India, and other places. In 1796, Edward Jenner, an English physician, developed a method of inoculating people with cowpox to protect them from smallpox. Inoculations to the surface of the skin are called *cutaneous* inoculations; those under the skin, *subcutaneous;* those into muscle tissue, *intramuscular;* and those into a vein, *intravenous.* Alan R. Hinman

Related articles in *World Book* include:

Disease (Preventing disease)	Jenner, Edward	Serum
Immunization	Poliomyelitis	Smallpox
	Salk, Jonas E.	

Inorganic chemistry is the study of the chemical elements and their compounds except most carbon compounds. These carbon-containing compounds are called *organic compounds.* Inorganic chemists make new compounds, determine the arrangement of atoms in inorganic compounds, and study how these compounds react with each other. There are more than 100 elements, and their reactions with each other can produce millions of compounds. Most of these compounds have yet to be prepared.

One important class of inorganic compounds, called *coordination compounds,* contains a central metal atom surrounded by nonmetal atoms. For example, *hemoglobin,* the large, red molecule that carries oxygen in the blood, contains iron atoms that are each surrounded by nitrogen and oxygen atoms. Another important group of inorganic compounds consists of nonmetal elements, including boron, nitrogen, oxygen, and silicon. Atoms of oxygen and silicon, for example, alternate in long chains that form the backbone of silicone rubber molecules. Many other inorganic compounds are solids that have no identifiable molecules. They include table salt and the minerals that make up rocks.

In industry, inorganic chemists work to develop materials that are important in our lives. These materials include coordination compounds that stop the growth of cancer cells; glass fibers that transmit telephone messages with light; and ceramics that lose their electric resistance and become superconductors when cooled.

Duward F. Shriver

Input-output analysis is a method of studying the complex relationships between the various parts of an economy. The method has a variety of uses in both government and business. It was developed in the 1920's by the American economist Wassily Leontief.

Input-output tables. In most cases, input-output analysis involves the use of extremely complex numerical tables. A greatly simplified input-output table accompanies this article. The table describes the annual activity of an imaginary national economy that has only three industries. The purple area of the table presents the outputs of each industry as inputs of the same industry or of another industry. Each number represents sales from firms in an industry at the left of the horizontal rows to firms in an industry at the top of the vertical rows. Thus, the number *12* indicates that annual sales from manufacturing firms to agricultural firms total $12 billion.

The blue portion of the table, which is labeled *Final markets,* shows the nonindustrial and nondomestic destinations of the goods or services produced by each industry. For example, the table indicates that individuals purchase $25 billion worth of agricultural products, the government buys $4 billion, and $7 billion is exported.

The red portion of the table deals with *value added.* In input-output tables, value added is the value of an industry's output minus the value of the inputs its firms purchase from other industries or from other firms within the industry itself. Value added roughly equals the industry's profits plus the wages the industry pays its workers. The table shows that the wages paid by agriculture are $22 billion and that the industry's profits are $3 billion. Note that each industry's horizontal-row total equals its vertical-row total. The sum of either the horizontal-row totals or the vertical-row totals for all industries yields the nation's gross domestic product (GDP).

Uses. Input-output tables have many uses. For example, economists can use them to predict the impact on an economy of an expansion in the automobile industry. Such a prediction can be made by examining the industries whose outputs are inputs for the automobile industry. The tables can also be used to predict the economic

impact of a new tax policy or of an increase in imports.

Donald W. Kroeber

Inquest is an inquiry held by a group of people who have the legal right to make an investigation. The word *inquest* comes from a Latin word meaning *to inquire* or *to search.* Inquests are held to get various types of information. In the United States and Canada, the most common inquest is the *coroner's inquest.* This type of inquest investigates the circumstances surrounding a death when the cause is unknown or foul play is suspected. The coroner of a county chooses a jury, generally from the voter registration rolls, and this jury reports its findings to the coroner. The report may be used by a grand jury as the basis of a murder indictment. See also Autopsy; Medical examiner.

John I. Thornton

Inquisition, *IHN kwuh ZIHSH uhn,* was an effort by the Roman Catholic Church to seek out and punish *heretics* (persons who opposed church teachings). The Inquisition took place in many parts of Europe, but the Spanish Inquisition is best known.

In A.D. 392, Roman Emperor Theodosius I outlawed all non-Christian and non-Jewish worship. From then on, the teachings of the Christian church were regarded as the foundation of law and order. Heresy was thus an offense against the state as well as the church.

During the 1100's and 1200's, certain groups of Roman Catholics revolted against their church. After some civil rulers refused or became unable to punish these heretics, the church took over the role. In 1231, Pope Gregory IX created a special court to investigate suspects and force heretics to change their beliefs. In 1542, the Congregation of the Holy Office took control of the Inquisition. The judges of the Inquisition were usually Dominican and Franciscan friars.

The Inquisition operated chiefly in France, Germany, Italy, and Spain. Working in secret, the inquisitors often misused their power. Some suspects were tortured, and heretics who refused to change their beliefs were sentenced to die by burning. In the 1500's, Catholic leaders turned the Inquisition against the Protestants.

Catholics now condemn the Inquisition for violating modern standards of justice. But in the Middle Ages, few people criticized it. John Patrick Donnelly

See also Torquemada, Tomás de; Heresy.

Insanity is a legal term for any severe mental disease or disorder that makes a person not responsible for his or her actions. Under most systems of criminal law, an insane person cannot be guilty of a crime. Thus insanity is used as a defense in some criminal cases. However, a defendant found not guilty by reason of insanity may be considered dangerous and be hospitalized until he or she is no longer mentally ill.

Forms of the insanity defense have been recognized by judges since ancient times. The landmark case in the modern development of this defense is *M'Naghten's Case,* decided in Britain in 1843. Daniel M'Naghten, who had been charged with murder, was judged not guilty by reason of insanity because of medical findings that a mental illness prevented him from being responsible for his actions. The case led to a new standard for the insanity defense called the M'Naghten Rule. This rule recognized insanity if a mental disorder prevented a defendant either from knowing what he or she was doing or from understanding that the action was a crime. British law and a large number of U.S. states still use the M'Naghten Rule.

Some U.S. states later adopted an "irresistible impulse" test. The "irresistible impulse" test recognizes insanity if a mental disorder prevented a defendant from resisting a sudden urge that led to criminal conduct. Another test came into wide use after it was proposed in 1962 by the American Law Institute, a group of legal scholars. This test requires that a mental disorder affected a defendant's ability either to understand the wrongfulness of his or her conduct or to control the illegal behavior.

In 1982, John W. Hinckley, Jr., who had tried to assassinate President Ronald Reagan, was found not guilty by reason of insanity. Soon afterward, Congress began debate that led to a 1984 insanity law for federal trials. This law requires the defense to prove the offender did not appreciate the nature and quality of his or her acts or the wrongfulness of these acts because of a mental disorder. Many states also require the defense to prove insanity, while others require the prosecutors to prove the defendant is sane. A few states do not recognize the insanity defense. Donald H. J. Hermann

See also Incompetence.

Inscription. See Engraving; Hieroglyphics; Seal.

Input-output table*

	Inputs			Final markets			Horizontal – row totals
Outputs	Agriculture	Manufacturing	Services	Individuals	Government	Export	
Agriculture	3	1		25	4	7	40
Manufacturing	12	27	8	48	25	9	129
Services		15	3	152	41		211
Value added							
Wages	22	75	178				
Profits	3	11	22				
Vertical – raw totals	40	129	211				380 (GDP)

*Figures are in billions of dollars.

Walkingstick
Diapheromera femorata
Life size

The variety of insect shapes is almost endless. The walkingstick looks so much like a twig that the insect's enemies may not notice it.

Fairy fly
Alaptus magnanimus
Greatly enlarged

Goliath beetle
Goliathus goliathus
Life size

Insects vary greatly in size. The Goliath beetle, one of the largest insects, grows about 4 inches (10 centimeters) long. The fairy fly, one of the smallest insects, can barely be seen by the unaided eye.

WORLD BOOK illustrations by Tom Dolan

Insect

Insect is a small, six-legged animal. Bees, ants, wasps, butterflies, cockroaches, fireflies, termites, and moths are insects. So are house flies, dragonflies, mosquitoes, grasshoppers, lice, crickets, walkingsticks, and fleas. The list could go on and on. If the scientific names of all the kinds of insects were printed in *World Book,* it would take more than 6,000 pages to list them.

Scientists have described and named more than 1 $\frac{1}{2}$ million species of animals. Of these, about 1 million are insects. Scientists discover thousands of new species of insects every year. They believe there may be from 5 million to 30 million species still undiscovered.

Insects live almost everywhere on earth—from steamy tropical jungles to cold polar regions. They live high on snow-capped mountains, and in deserts below sea level. They can be found in caves deep in the earth, or flying high in the sky. Only in the oceans are few insects found.

We are constantly at war with some insects. They annoy us, bite us, and infect us with deadly germs and parasites. They attack our crops, our pets, and our domestic animals. They invade our homes, eat our food, and damage our property. But insects also have great value to us. They pollinate many of our crops, provide us with such products as honey and silk, and serve as food for fish, birds, and many other animals. They even help recycle decaying plant and animal material. In fact, life as we know it could not exist if all the insects disappeared.

E. W. Cupp, the contributor of this article, is Professor of Entomology at Auburn University.

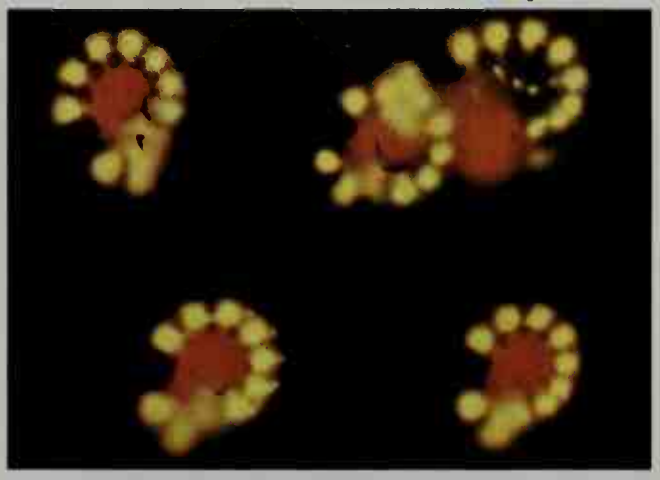
WORLD BOOK photo courtesy Field Museum of Natural History

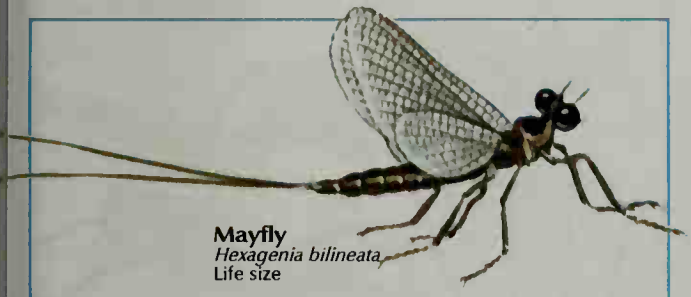
Fossil insects indicate that insects have lived on the earth at least 400 million years. This fossil dragonfly, shown half actual size, is about 150 million years old.

Moth
Chrysiridia madagascarensis
Life size

The gorgeous colors of some insects make them among the most beautiful of all animals. An outstanding example is the moth *Chrysiridia madagascarensis, above,* found on the island of Madagascar, off the southeastern coast of Africa. Many insects glow in the dark. These railroad worms, *below,* were photographed in their own light. The insects, shown about life size, are the larvae of a South American beetle.

Life magazine © Time Inc.





Mayfly
Hexagenia bilineata
Life size

Queen termite
Macrotermes bellicosus
Grows more than 4 inches (10 centimeters) long when swollen with eggs

The life span of insects ranges from a few days or hours for adult mayflies to 20 years or more for some queen termites. Most insects live less than a year.

Insects rank among the most fascinating animals on earth. They smell chiefly with their antennae, and some taste with their feet. Many insects hear by means of structures on their bodies called "hairs." These structures resemble the true hairs of mammals. Other insects have "ears" on their legs or on the sides of their bodies. Insects have no voices, but some make noises that can be heard 1 mile (1.6 kilometers) away. Insects have no lungs, but breathe through holes in their sides. Some insects have no eyes, and others possess five eyes or more. Many insects have enormous strength. An ant can lift a weight 30 times as heavy as its body. If a 200-pound (91-kilogram) man could do as well, he could lift 3 tons (2.7 metric tons)—with his teeth. A flea can broad-jump about 13 inches (33 centimeters). If a human being could do as well, he or she could jump 700 feet (210 meters).

Many insects do the same things we do. They build bridges and apartment houses. Some raise crops, and others keep "cattle" that they "milk." There are also insect carpenters, papermakers, guards, soldiers, nurses, slaves, hunters, trappers, thieves, and undertakers. Some insects even go to war against one another.

Many people think that such animals as spiders, centipedes, mites, and ticks are insects. But these animals differ from insects. For example, spiders have eight legs, and insects have six. A spider's body is divided into two main parts, but an insect's body has three. Most insects have wings and antennae, but spiders do not.

This article discusses insects in general. It tells why insects are important and why they have become the largest group of animals. It describes body features and habits that most insects have in common—and some of the many differences in body features and habits. Various other *World Book* articles discuss specific insects.

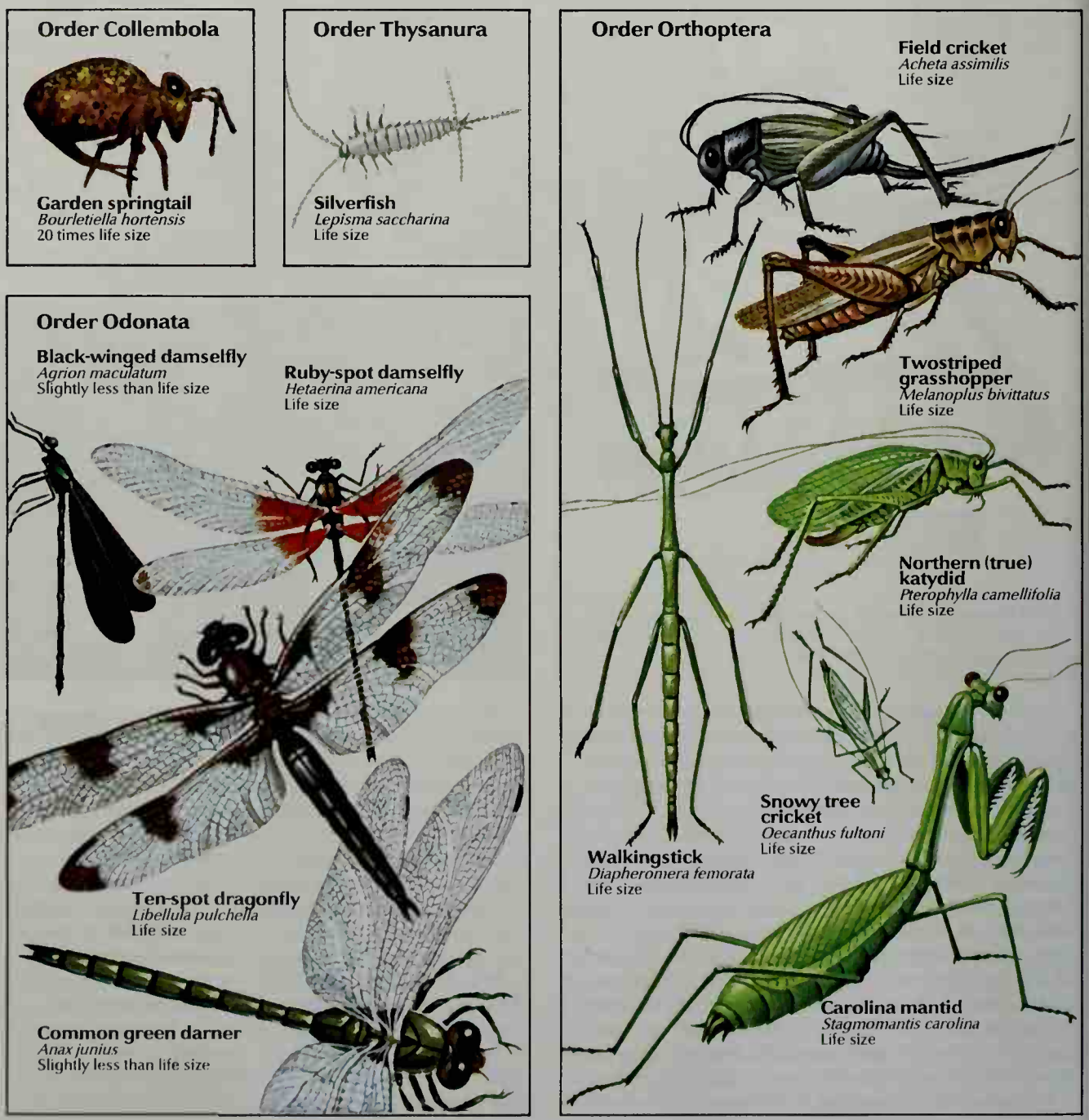
The story of insects is a tremendous success story. Insects first appeared on earth at least 400 million years ago. Down through the ages, they have struggled endlessly to survive. During this struggle, insects have gradually developed an incredible variety of body forms and ways of life. They have adapted themselves to almost all types of living conditions. Insects have been so successful in their fight for life that they are often said to be the only rivals of humans for control of the earth.

Today, there are at least four times as many kinds of insects as all other kinds of animals combined. The total number of individual insects is astonishing. Scientists estimate that the average number of insects for each 1 square mile (2.6 square kilometers) of land equals the total number of people on the earth.

About 1 million species of insects have been classified by *entomologists* (scientists who study insects) into major groups called *orders*. These orders are based on general body characteristics and other features. For example, all butterflies and moths make up the order Lepidoptera, and all beetles make up the order Coleoptera. The insect orders and the characteristics of each are given in the table *The orders of insects* in this article. See also the **Classification, Scientific** article.

The variety of insects. The world of insects includes some of the most beautiful and fantastic animals on

Familiar kinds of insects



the earth. No other branch of the animal kingdom has such great variety in size, color, and form.

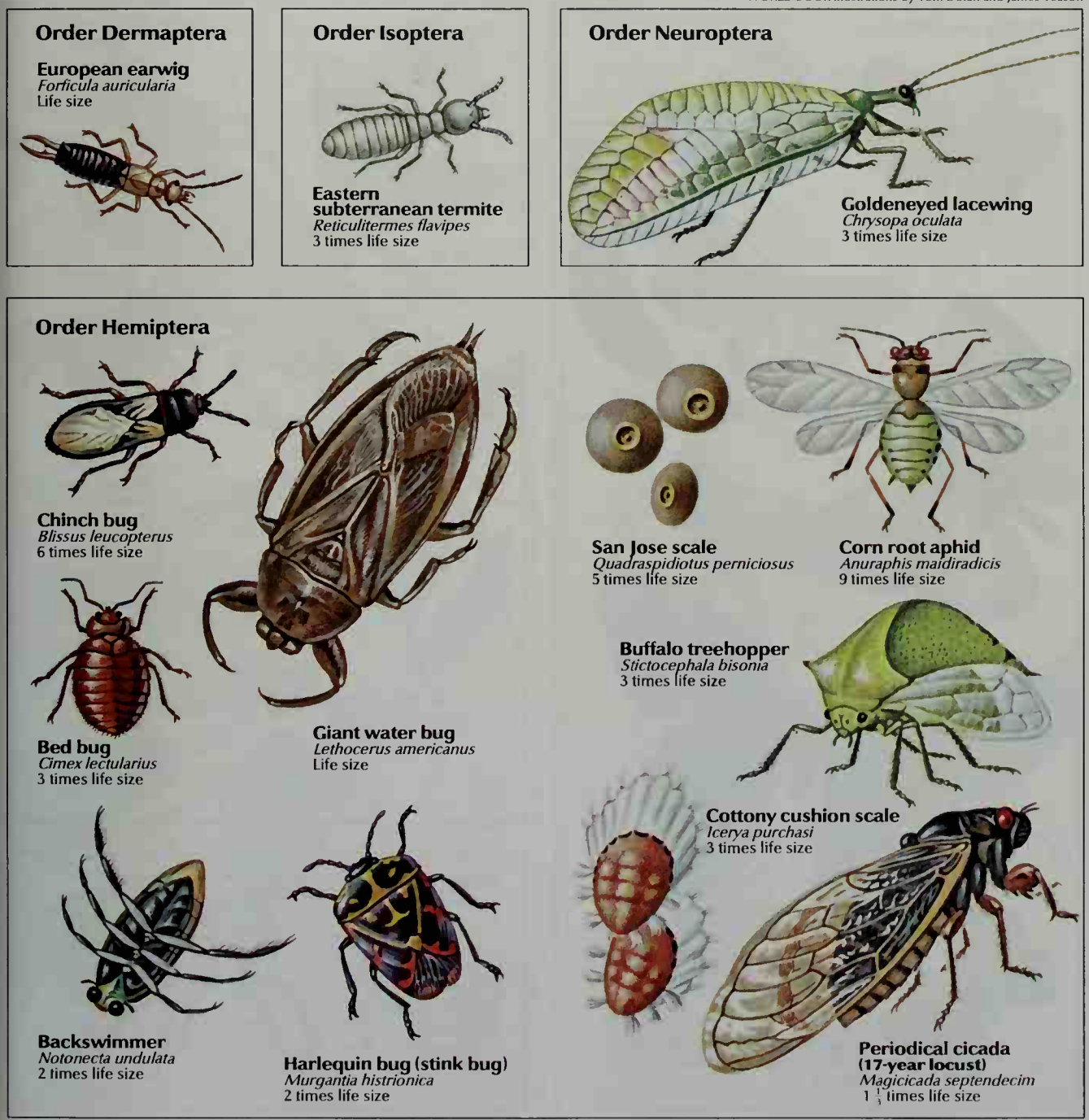
Most insects measure less than $\frac{1}{4}$ inch (6.4 millimeters) long. The smallest ones include fairy flies and certain kinds of beetles. These insects are about $\frac{1}{100}$ inch (0.25 millimeter) long, and they could easily crawl through the eye of the smallest needle.

Giant insects include Goliath beetles, which grow to more than 4 inches (10 centimeters) long; certain Asian species of walkingsticks, which measure about 13 inches (33 centimeters) long; and the giant owl moth, which has a wingspread of about 12 inches (30 centimeters). A giant owl moth is about 1,200 times as large as a fairy fly.

There are insects of all colors of the rainbow. Some butterflies and moths, with their gorgeous color patterns, rank among the most beautiful of all the animals in the world. Insect collectors prize many kinds of beetles for their brilliant metallic colors. Many insects blend in with their backgrounds. For example, most of the beetles that live in the ground are either black or brown. Some kinds of moths have the color of the bark of trees.

Insects have an amazing variety of shapes and special structures. Some insects look like sticks, green leaves, dry leaves, or snail shells. Others resemble thorns, dry reeds, or bird droppings. Ichneumon wasps have an egg-laying tool up to about 4 $\frac{1}{2}$ inches (11.4 centimeters)

WORLD BOOK illustrations by Tom Dolan and James Teason

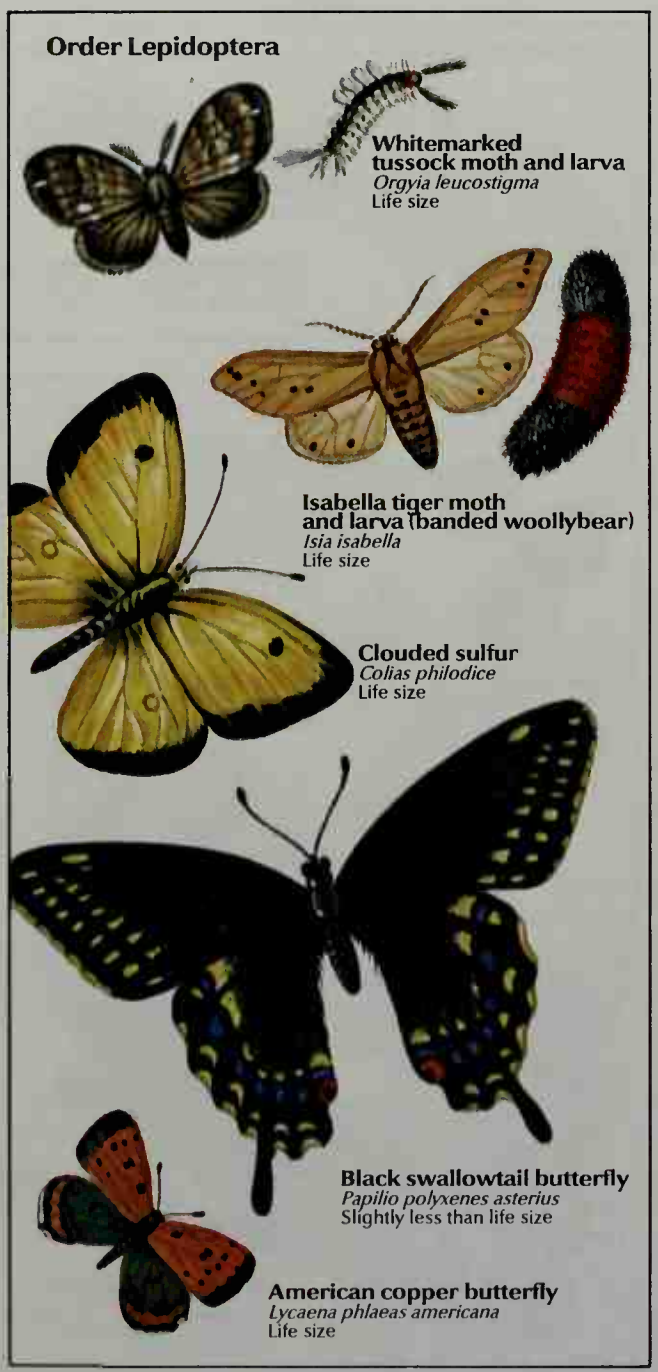


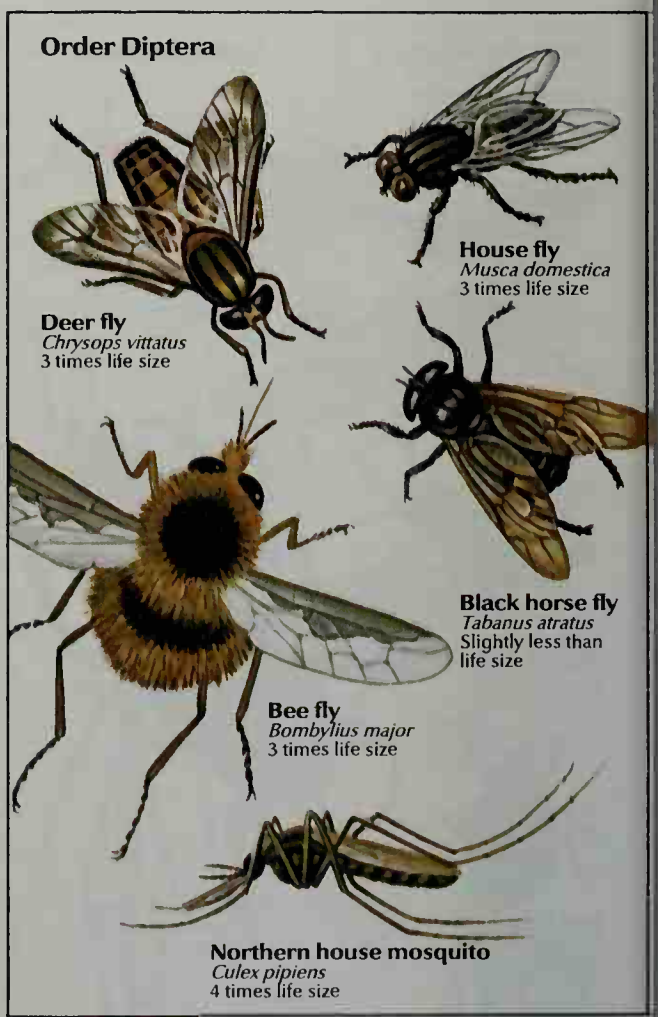
long that can drill through solid wood. The egg-laying tool of bees, wasps, and some ants has become a poisonous sting. The eyes of stalk-eyed flies are on the ends of slender stalks. Water scorpions have a snorkellike device that they push up through the water to get air. Nut weevils have a long, slender beak—often as long as the rest of their bodies—which they use to bore into nuts. Backswimmers have long hind legs, which they use like a pair of oars. Some stag beetles have jaws as long as their bodies and branched like antlers.

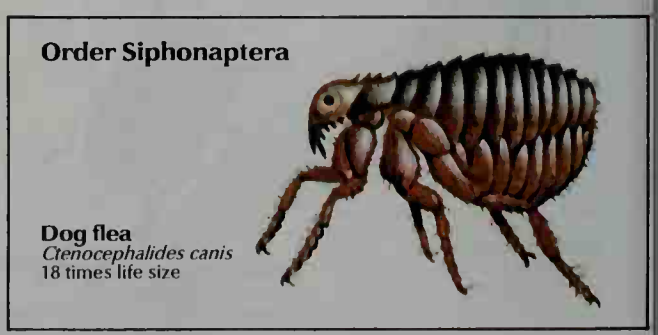
Why insects are so successful. Insects have had such enormous success in their struggle for survival for several reasons. One is that they can adapt to even the harshest living conditions. The young of some insects live in pools of crude oil. Others live in embalming solutions. Some live in streams where the temperature falls to 32 °F (0 °C), the freezing point of water. Others live in hot springs where the temperature rises to 120 °F (49 °C). Insects have been frozen solid below 0 °F (−18 °C) and lived. Some have been put into a vacuum as great as people can create, and survived. Although most insects feed on plant life, many have adapted themselves to eating almost anything. Various kinds of insects eat fabrics, opium, mustard plaster, cork, tobacco, face powder, paste, or pepper.

Another reason for insects' success is their small

Familiar kinds of insects







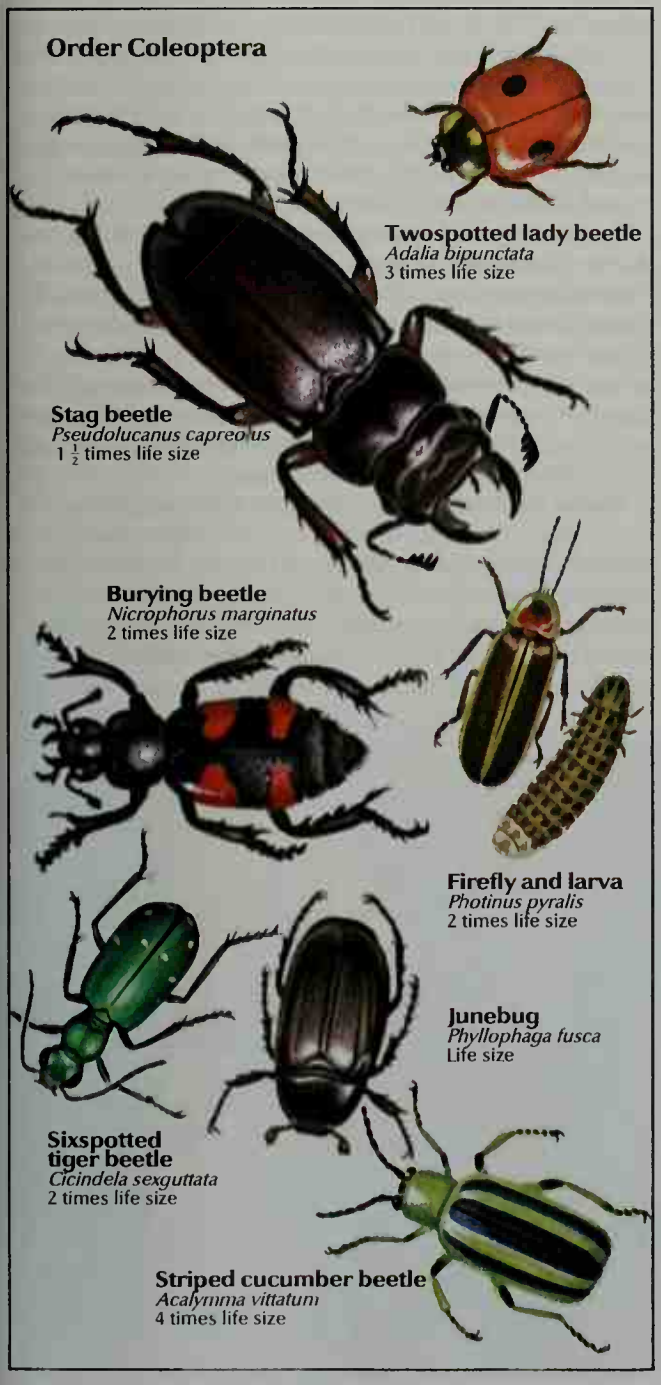
size. Insects can live in places that are too small for other animals, and where they can also find food and protection from enemies. Some insects live between the thin walls of a leaf. Some develop within a small seed or within the eggs of other insects. Because insects are small, they need little food. A crumb provides a banquet for an insect.

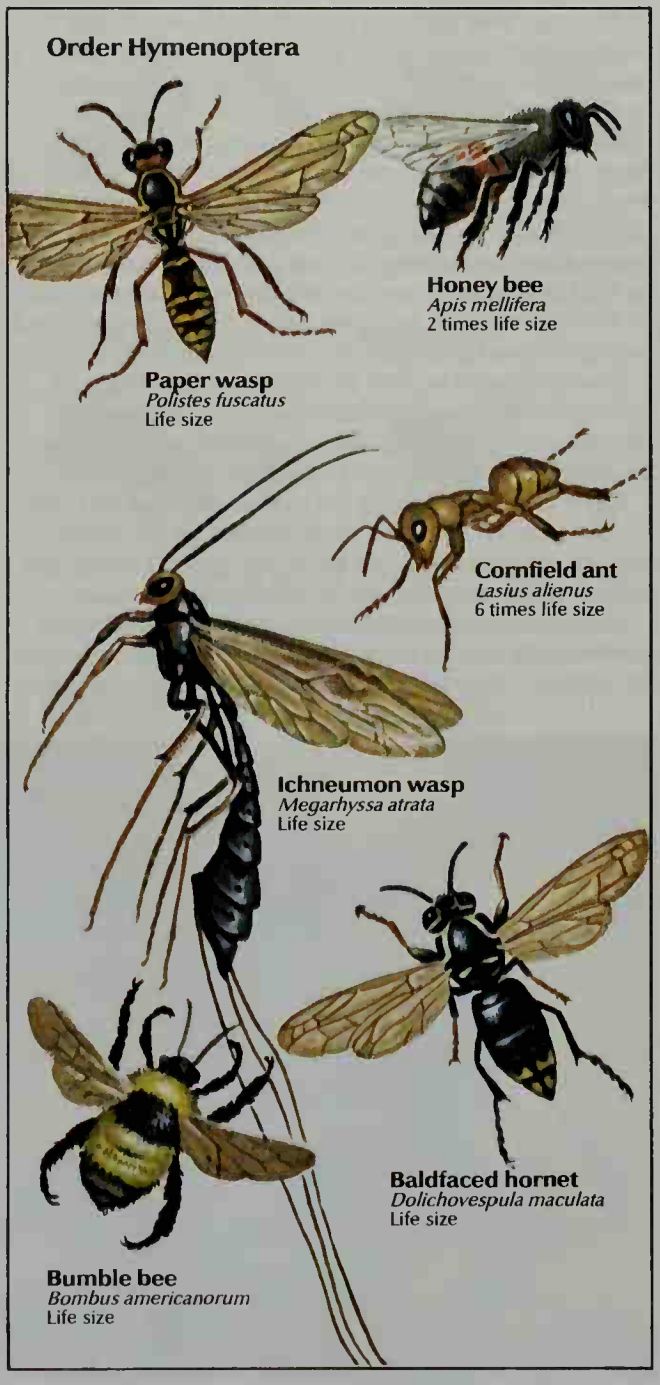
The skeleton of insects also has helped them survive. An insect has its skeleton on the outside of its body. This tough coat of armor protects the animal's internal organs against injury and loss of moisture.

Most insects have wings, which give them a great advantage over most other kinds of animals. Flying makes it easier for insects to search for food, to escape from enemies, and to find mates.

Much of the success of insects results from their powers of reproduction. Most insects have short lives. They quickly become adults and reproduce. Most insects lay many eggs. Many kinds produce several generations during a season. Because insects can reproduce so rapidly and in such great numbers, they can change to meet changes in their surroundings that could otherwise wipe them out. Insects also have special methods of reproduction. The females of some species can reproduce without mating. A queen honey bee, after one mating period, can lay eggs for the rest of her life.

WORLD BOOK illustrations by Tom Dolan and James Teason





The importance of insects

Insects are often grouped as beneficial or harmful, but this grouping is somewhat artificial. All insects form part of the great web of life that includes human beings and all other living things. Insects feed on plants and animals, but they also are food for plants and animals. Insects thus help keep in balance the total number of plants and animals on the earth (see **Balance of nature**). If all insects disappeared, the earth would be completely changed. People probably could not survive.

Beneficial insects include bees, wasps, flies, butterflies, moths, and others that pollinate plants. In the United States, the value of crops that require or benefit from pollination by insects totals billions of dollars a year. Many fruits, including oranges, apples, plums, strawberries, blackberries, pears, and grapes, depend on insect pollinators for the production of seeds. So do such vegetables and field crops as peas, onions, carrots, cabbages, clover, and alfalfa. Insects also pollinate carnations, morning-glories, orchids, magnolias, and other lovely flowers. See **Pollen**.

Insects are an important food source for birds, fish, frogs, lizards, skunks, and many other animals. Insects even serve as food for such plants as Venus's-flytraps, pitcher plants, and sundews. People also eat insects. In South Africa, some people roast termites and eat them by the handful, like popcorn. Mexicans make a cake out of the eggs of water boatmen. Many U.S. stores sell fried caterpillars and chocolate-covered bees and ants.

Insects provide us with products worth millions of dollars yearly. These products include honey and beeswax, made by bees; shellac, made from a substance given off by lac insects; and silk, made by silkworms.

Many insects help keep the landscape clean by feeding on animal wastes and dead animals, or the remains of dead plants. Insects that live in the ground enrich the soil with their waste products and dead bodies.

Many insects are beneficial because they are *predators* (animals that eat other animals). They feed on harmful insects. One predator, the ladybug, eats several kinds of crop-destroying insects. Other helpful insects are the *parasites* that live in or on the bodies of harmful insects. For example, some wasps lay their eggs in caterpillars that damage tomato plants. As the young develop, they feed on the caterpillars and kill them.

Harmful insects. Less than 1 percent of the estimated 1 million species of insects are harmful. Of the many thousands of species in the United States, only a few hundred are serious pests. But the damage they do and the cost of controlling them total billions of dollars yearly. Insects attack and injure almost all types of plants. Every year, insects destroy more than 10 percent of the crops raised in the United States. Major pests include boll weevils and bollworms, which damage cotton; Hessian flies, which attack wheat, barley, and rye; corn earworms and chinch bugs, which destroy corn and other crops; and Colorado potato beetles, which eat potatoes.

Many insects are household pests. Clothes moths and carpet beetles ruin clothing, carpets, upholstery, and furs. Silverfish damage books. Termites attack furniture and the beams and floors of buildings. Ants, cockroaches, flies, and many other insects eat or spoil the food stored in homes and warehouses.

The worst insect enemies are probably those that endanger our health. Many fleas, lice, and other parasites may cause soreness, damage to tissues, or occasionally death. House flies and blow flies often carry germs that cause typhoid fever, cholera, dysentery, or other diseases. Many bloodsucking insects carry such deadly diseases as malaria, African sleeping sickness, or plague. In addition, the bites of numerous flies and bugs can cause persistent discomfort and even shock.

Insect control. People use many methods to control insect pests. Some methods are simple. Flies can be swatted, or beetles merely picked off plants. The careful draining of swamps can destroy mosquito breeding places without harming other organisms. The young of house flies can be killed by burning the rubbish in which they live. Other control methods require more ex-

Alexander B. Klots

Pollination by insects is worth billions of dollars yearly to United States agriculture. This bee, its hairy body covered with pollen, is visiting a goldenrod blossom.

pertise. These include (1) quarantine systems, (2) cultural control, (3) biological control, and (4) chemical control.

Quarantine systems try to prevent insect pests from entering a country. Pests are often imported accidentally on ships, planes, or other vehicles. In many countries, government inspectors examine baggage and cargo for pests at the borders and chief points of entry. Some of the worst imported pests include the boll weevil, Japanese beetle, gypsy moth, and Hessian fly.

Cultural control is a way of preventing insect damage through better farming methods. One method is crop rotation, which stops the increase in insects that feed on one kind of plant. Another method of cultural control is to schedule planting and harvesting so they are not done when insects lay eggs or are most numerous.

Biological control is the use of predators, parasites, or microscopic organisms to check pests. A spectacular example of this method took place in the late 1800's. The cottony cushion scale, an insect accidentally imported from Australia, had almost destroyed California's lemon and orange groves. The fruit growers brought in ladybugs, which kept the pests under control in their native land. The ladybugs had the scales in check within two years, and saved the citrus groves. Another method of biological control *sterilizes* insects by radiation or chemicals so they cannot reproduce. This method was used successfully in the 1950's against screwworms that had attacked livestock in the Southeastern United States.

Chemical control chiefly involves the use of insecticides. But some insecticides may harm people or upset the balance of nature by destroying beneficial as well as harmful insects. In addition, some harmful insects become resistant to insecticides after a few generations. See **Insecticide**.

The most effective pest control plans combine more than one of these control methods. For example, *integrated pest management* combines cultural, biological, and chemical control methods.

Insect predators help people by eating harmful insects. This ladybug is preying on aphids, pests that attack many plants.

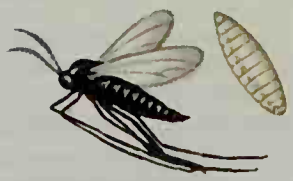
Edward S. Ross

Some common insect pests

Boll weevil
Anthonomus grandis

Adults and grubs attack cotton by damaging the *bolls* (seed pods) and other parts.

Hessian fly
Mayetiola destructor



Maggots hurt wheat crops by sucking juice from the stems of wheat plants.

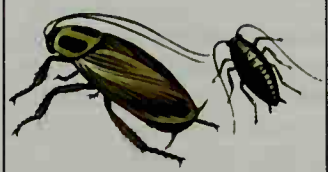
Corn earworm
Helicoverpa zea

Caterpillars cause damage to the ears of corn plants and to parts of cotton plants.

Carpet beetle
Anthrenus scrophulariae

Grubs eat holes in rugs, upholstery, and other goods made of animal products.

German cockroach
Blattella germanica



Adults and nymphs eat or soil food in homes, groceries, and restaurants.

Bluebottle fly
Calliphora vomitoria

Maggots breed in filth, and the adults may carry harmful germs.

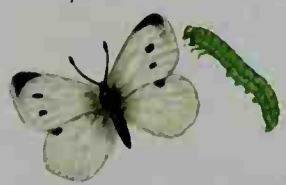
Japanese beetle
Popillia japonica

Adults attack the leaves and fruit of about 275 kinds of plants. Grubs eat roots.

Gypsy moth
Lymantria dispar

Caterpillars strip the leaves from almost all kinds of trees, killing many trees.

Imported cabbageworm
Pieris rapae



Caterpillars badly damage the leaves of cabbage, cauliflower, and related plants.

Screwworm
Cochliomyia hominivorax

Adults lay eggs in animals' sores. Maggots eat into the flesh, often causing death.

WORLD BOOK illustrations by Tom Dolan

Adult insects have three pairs of legs, a body divided into three main parts—head, thorax, and abdomen—and a tough shell-like outer covering. Most insects also have wings and a pair of antennae.

Skeleton

The skeleton of an insect is on the outside of its body, and is called an *exoskeleton.* It is made up of several substances, the best known of which is *chitin.* The exoskeleton is lighter and stronger than bone, and serves as a suit of armor that protects the internal organs. The insect's muscles are attached to the inside wall of the exoskeleton.

The exoskeleton does not grow with an insect, as do the bones of a child. In time, the exoskeleton becomes too tight and must be shed. This process is called *molting.* The insect forms a new suit of armor underneath before it crawls out of the old suit. The new exoskeleton is soft, and so the insect gulps air to stretch it before the suit hardens. This process provides growing room until the next molt. Most insects continue to molt until they become adults.

The exoskeleton of an adult insect consists of about 20 ringlike parts. Some of these segments have become so completely *fused* (joined together) that they cannot be seen. Other segments are connected by flexible areas that serve as joints. The segments are grouped into the three main parts that make up the insect's body.

Head

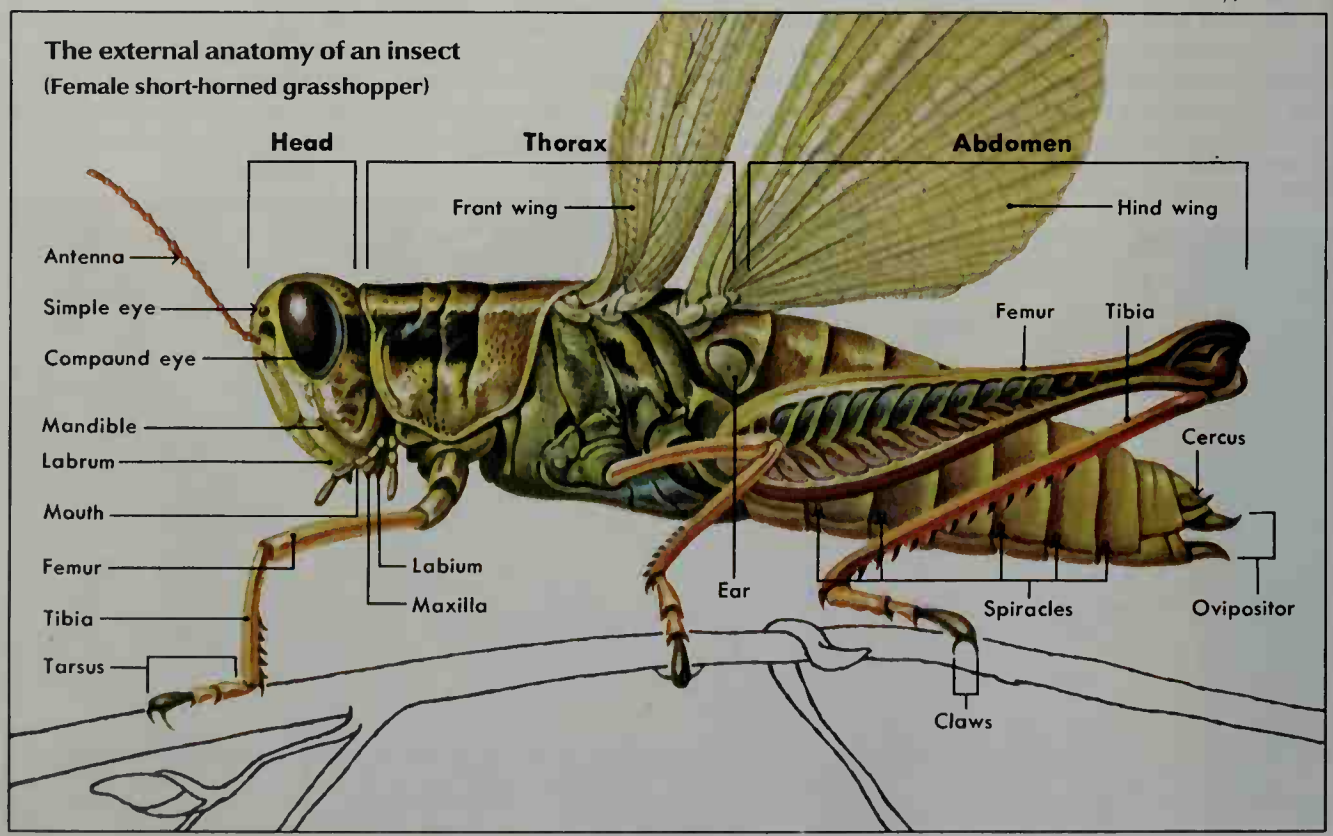
An insect's head consists of five or six segments, but they are too tightly fused to be seen. The head includes the mouthparts, eyes, and antennae.

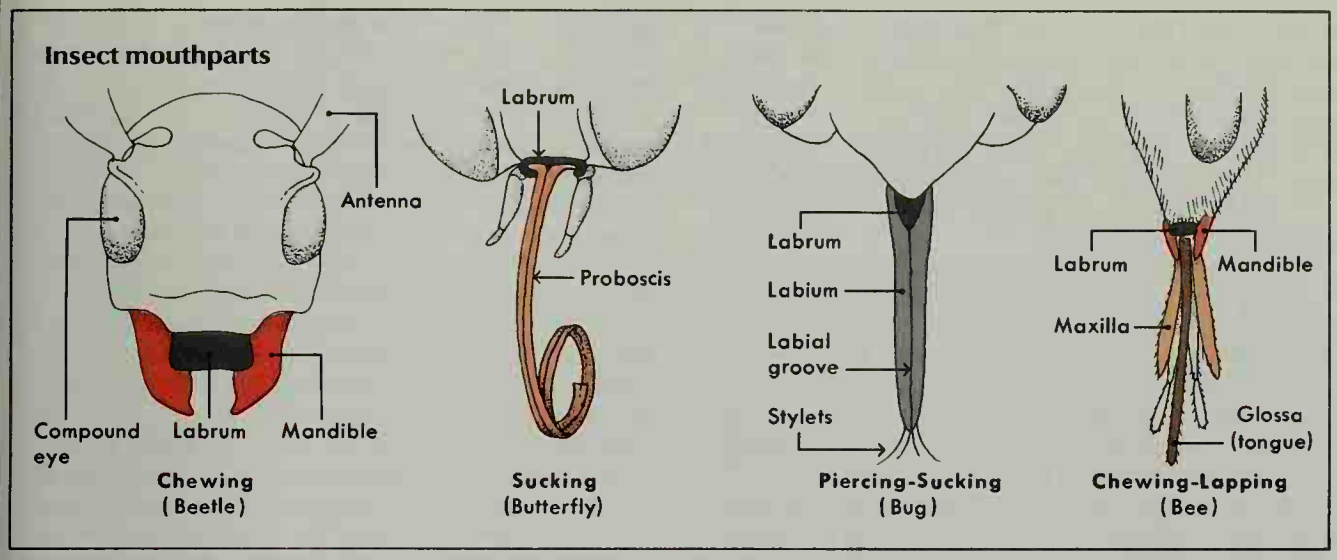
Mouthparts are a set of structures used for feeding. These structures surround the insect's actual mouth, which is merely an opening in the head. The parts differ among insects, according to how the animal feeds. There are two main types of mouthparts. One type is adapted for chewing, and the other for sucking. Each order of insects has its own variation of one of these types, or a combination of both.

Chewing insects include grasshoppers, crickets, beetles, termites, and cockroaches. These insects have two powerful grinding jaws called *mandibles.* The jaws, which in most species are lined with teeth, work sideways, not up and down as ours do. An insect uses its jaws not only for chewing, but also for cutting or tearing off food. A second pair of less powerful jaws, called *maxillae,* is behind the mandibles. They also move sideways, and are used for handling food and pushing it down the throat. Chewing insects have two lips. The upper lip, called the *labrum,* is simply a flap that hangs down over the mouthparts and covers the mouth from the front. The lower lip, called the *labium,* covers the mouth from behind.

Sucking insects have mouthparts that developed from the basic chewing structures. The mouthparts of some sucking insects have changed so much to suit the animals' feeding habits that they are hard to recognize. The labium of bedbugs, chinch bugs, and other bugs has become a long, grooved beak. Four slender, sharp needles called *stylets* lie in the groove. The stylets developed from the mandibles and the maxillae. They are used for piercing plants or animals and then sucking up the juices or blood. The labrum serves as a flap that covers the groove in the beak.

WORLD BOOK illustration by James Teason





In butterflies and moths, the mandibles have almost disappeared. Parts of the maxillae have become greatly lengthened and joined together to form a long, slender drinking tube. This tube, the *proboscis,* coils up when the insect is not using it to suck liquids, such as nectar from flowers. In horse flies, the mandibles have become curved swords that can slash an animal's skin. The maxillae have developed into sharp-pointed rods that can be driven up and down into the victim's skin like a pneumatic drill. To feed, a horse fly plunges its sucking tube, formed from the labrum, into the bleeding wound made by the cutting tools.

Eyes and antennae. Most adult insects have two enormous *compound eyes.* These eyes are made up of separate lenses—as many as thousands of them. All the lenses combine to form a complete picture of what an insect sees.

Almost all insects have two antennae between their eyes. They use their antennae chiefly to smell and to feel. Many also use their antennae to hear, and some use them to taste. Most insects become distressed if their antennae are damaged or removed, and some become helpless. For more information on insect eyes and antennae, see *The senses of insects* in this article.

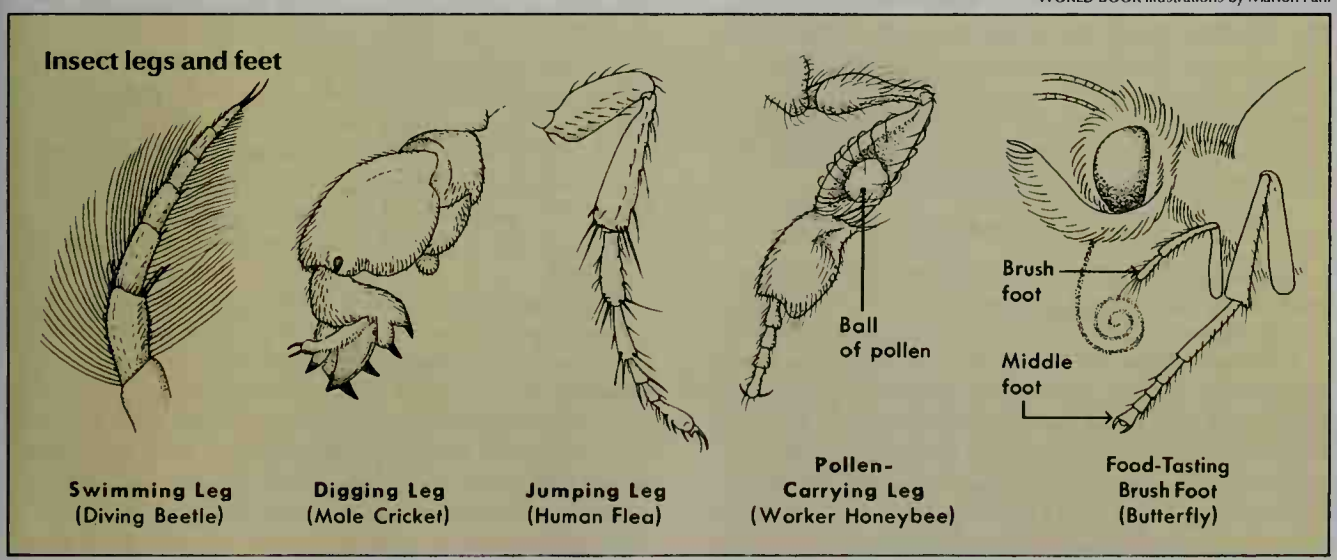
Thorax

The thorax is the middle section of an insect's body. It consists of three tightly fused segments. The muscles that operate the legs and wings are attached to the inside wall of the thorax.

Legs. One pair of legs is connected to each segment of the thorax. Each leg has five main segments, with movable joints between the segments. When we walk, we balance ourselves on one leg as we step forward with the other. When insects walk, they usually move the middle leg on one side at the same time they move the front and hind legs on the other. In this way, they are always firmly supported—like a three-legged stool.

Many kinds of insects have legs adapted for special tasks. Giant water bugs, backswimmers, diving beetles, and a number of other insects that swim have long, flat hind legs that work like oars. Mole crickets and many types of dung beetles have strong, flat front legs that serve as shovels for digging. Locusts, fleas, and grass-

WORLD BOOK illustrations by Marion Pahl



hoppers have long, muscular hind legs adapted for jumping. Honey bees have pollen-collecting brushes on their front legs and pollen-carrying baskets on their hind legs. Many kinds of butterflies have small, hairy front legs with special organs for finding food. Flies and bees have hooks and sticky pads on their feet. These insects can walk on slippery surfaces, up and down walls, and upside down on ceilings.

Wings. Insects are the only animals besides birds and bats that have wings. Most adult insects have them. House flies, mosquitoes, tsetse flies, and all other true flies have two wings, which are attached to the middle segment of the thorax. Butterflies, dragonflies, moths, wasps, bees, and other winged insects have four wings. One pair is attached to the middle segment of the thorax, and the other pair to the hind segment.

Insects get their flying power from two sets of muscles. One set extends from top to bottom of the thorax. When these muscles contract, the thorax flattens, causing the wings to move up. The other set of muscles extends lengthwise. When they contract, the thorax arches upward, causing the wings to move down. As the two sets of muscles flatten and arch the thorax, they cause the wings to beat. Other muscles are attached directly to the bases of the wings, and control the direction of flight. They make it possible for many insects to fly in one place like a helicopter, or even to fly backward.

Among insects that have four wings, the two wings on each side often work together as if they were one wing. In some groups of insects, the two wings on each side overlap. In other groups, they lock together by means of hooks or hairs. Dragonflies beat their two pairs of wings alternately, with the front pair rising as the rear pair falls. Beetles do not use their front wings for flight. These wings form horny covers that protect the hind wings when the beetles are at rest. Flies have a pair of club-shaped balancing organs called *halteres,* which have replaced their hind wings. A fly usually will not try to fly if its halteres have been removed.

The fastest-flying insects are probably dragonflies. Some scientists estimate that these insects can fly as fast as 60 miles (97 kilometers) per hour. Butterflies and locusts can fly continuously for well over 100 miles (160 kilometers) on the food energy stored in their bodies. Tiny fruit flies can fly more than five hours without refueling. On the other hand, honey bees carry only enough fuel for a 15-minute flight. Large-winged butterflies beat their wings 4 to 20 times per second; house flies, about 200 times per second; and some midges, about 1,000 times per second.

Abdomen

An insect's abdomen contains organs for digesting food, reproducing, and getting rid of waste products. The abdomen consists of 10 or 11 segments connected by flexible membranes. These membranes make it possible for the ringlike segments to slide into one another, like a telescope, when the abdomen is empty. The segments spread far apart when the abdomen is full. The abdomen of a queen termite may be so swollen with eggs that it is more than 1,000 times as large as the rest of her body. In some ant colonies, certain ants serve as food storage tanks. Their abdomens bulge with liquid sugar, with which they can feed other ants. The storage ants give up the liquid sugar through their mouths.

Many insects have a pair of feelers, called *cerci,* on the last segment of the abdomen. Mayflies, stoneflies, and some cockroaches have especially long cerci. The cerci of earwigs and some other insects form a pair of tongs that are used for defense or for capturing prey.

The outer reproductive organs are attached to the eighth and ninth segments of the abdomen. In many males, these organs are part of a set of structures that hold the female during mating. The organs of many females are part of an egg-laying tool called the *ovipositor.* Females use the ovipositor to insert their eggs into such things as soil, wood, leaves, fruits, seeds, or the eggs or bodies of other animals. Some females have an ovipositor as long as or longer than the rest of the body. The ovipositor of bees, ants, and wasps has been adapted into a poisonous sting that can be withdrawn into the abdomen when not in use. Near the end of the abdomen is an opening called the *anus,* through which wastes and extra water pass from the insect's body.

Internal organs

The internal organs of insects, like those of other animals, are grouped into various systems. But these systems differ in many ways from those of other animals. The chief systems are the circulatory, respiratory, nervous, muscular, digestive, and reproductive systems.

Circulatory system carries blood through the body. An insect's blood does not flow through veins and arteries as ours does. Blood fills the whole cavity of the insect's body, and bathes all the organs and muscles. The blood is circulated by a long tube that lies just under the exoskeleton of the back. This tube extends almost the entire length of the body. The pumping part of the tube lies in the abdomen, and is called the *heart.* The front part of the tube extends into the head, and is called the *aorta.* Blood enters the tube through little openings, called *ostia,* along the sides. The openings have valves that allow blood to enter the tube, but not to flow out. As the heart contracts, the blood is forced along the tube and out through the aorta. The blood first bathes the brain, and then flows to other parts of the body. It then reenters the tube through the ostia.

An insect's blood, like ours, carries food and waste products to and from the cells of the body. But unlike our blood, it usually has nothing to do with bringing oxygen to the cells. Our blood contains a red pigment called *hemoglobin,* which carries oxygen to the cells. Nearly all insects do not have hemoglobin in their blood, and most insect blood is greenish, yellowish, or colorless.

Insects are *cold-blooded* animals. That is, the internal temperature of their bodies varies according to the temperature of the surrounding air. Insects cope with heat and cold in many ways. Strongly flying insects must have high body temperatures to fly. Large ones, such as hawk moths, bumble bees, and large beetles, raise their body temperatures by "shivering"—that is, by working their wing muscles against one another without actually flying. Smaller insects, such as many butterflies, flies, and

grasshoppers, may absorb sunlight to become warmer.

Respiratory system. An insect breathes by means of tiny holes, called *spiracles,* along the sides of its body. Each hole leads into a large tube called a *trachea.* The large tubes divide into small tubes, which, in turn, divide into still smaller tubes that branch out to all the cells of the body. This system of tubes carries oxygen to the cells and takes away carbon dioxide.

Nervous system consists of a brain, located in the head, and two nerve cords that lie side by side along the floor of the thorax and abdomen. The brain receives information from the eyes and antennae, and controls the insect's body activities as a whole. Another nerve center in the head is connected to the brain and controls the insect's mouthparts. Each of the two nerve cords contains a cluster of nerve cells, called a *ganglion,* in each segment of the thorax and abdomen. The two ganglia in each segment are fused and form a sort of little brain that controls the activities of that segment. The ganglia often can work without the brain. For example, many insects that have had their heads cut off can still walk, mate, and lay eggs. In some insects, the three pairs of ganglia in the thorax are fused into one. Various pairs of ganglia in the abdomen also are fused in many insects.

Muscular system is made up of many small but very strong muscles. Grasshoppers have about 900 muscles, and caterpillars have 2,000 to 4,000. People have fewer than 700 muscles. Many insects can lift or pull an object 20 or more times heavier than their body weight. Few people can lift anything heavier than their body weight.

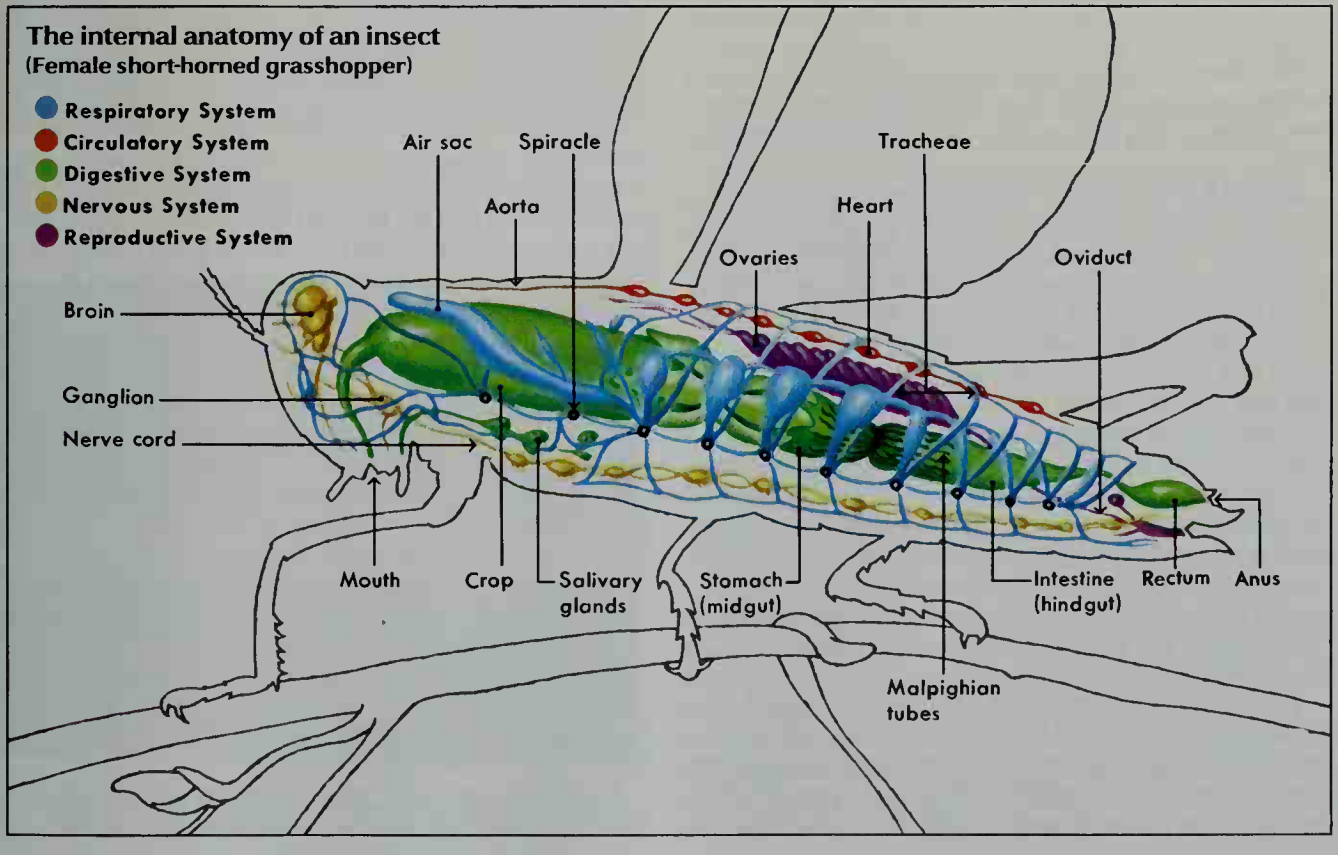
Digestive system of an insect consists basically of a long tube that extends from the mouth to the anus. The tube has three main divisions. They are (1) the foregut; (2) the midgut, or stomach; and (3) the hindgut, or intestine.

In insects that have chewing mouthparts, the food is chewed up and then enters the foregut through the mouth. The food moves along the tube until it reaches an enlarged area called the *crop,* where it is temporarily stored and partly digested. Then the food passes into the *gizzard,* which has thick muscular walls that contract and grind the food into small bits. The gizzard of some insects has teeth that help break up and grind the food. The food next passes into the midgut, where most digestion takes place. Nourishing parts of the food are absorbed into the blood, and wastes and undigested parts enter the hindgut. Insects with sucking mouthparts have a similar digestive process. But they suck up—rather than chew up—their food, and they often lack a gizzard.

Almost all insects have a system of 2 to over 250 *Malpighian tubes* attached to the digestive system where the midgut and hindgut join. The tubes absorb waste materials from the blood. The waste passes through the tubes into the hindgut. All wastes and extra water that enter the hindgut leave the body through the anus.

Reproductive system. Most insects reproduce sexually. That is, a new individual can be created only after a female sex cell, called an *egg,* has united with a male sex cell, called a *sperm.* The reproductive organs are in the abdomen. Females have two organs, called *ovaries,* in which eggs develop. A tube called an *oviduct* carries the eggs away from each ovary. The two oviducts join and form a single tube that opens near the tip of the abdomen. Male insects have two organs, called *testicles* or *testes,* that produce sperm. A tube carries the sperm from each testicle. The two tubes unite and form a single tube that extends to the outside of the abdomen.

WORLD BOOK illustration by James Teason



The senses of insects

Hermann Eisenbeiss, APF

The compound eyes of a wasp, like those of most insects, consist of many separate lenses. Each lens works independently, and so everything the insect sees is broken up into small parts.

Like other animals, insects have organs that allow them to see, hear, touch, taste, and smell. Many insects have senses much sharper than those of most other animals.

Sight. Most kinds of insects have two large compound eyes that occupy most of the head. Each eye is made up of tiny six-sided lenses that fit together like the cells of a honeycomb. The number of lenses varies from about 6 in some worker ants to about 30,000 in some dragonflies. Each lens admits a small part of the total scene that the insect sees. All the parts together combine and form the whole picture.

Insects cannot move or focus their eyes. They have sharp vision for only a short distance. They see objects more than 1 yard (0.9 meter) away as a blur. But insects can quickly see movements, and many can tell colors apart. Many insects also can see a broader range of light rays than people can. For example, some beetles can see infrared, and most insects can see ultraviolet light. Both are invisible to people. Insects have no eyelids. Their eyes are always open.

Many adult insects have three simple eyes, called *ocelli.* These eyes are set in the form of a triangle between the compound eyes. The simple eyes cannot form images. They can only tell the difference between light and dark. The young of many insects lack compound eyes, but they have from one to six or more simple eyes on each side of the head.

Hearing. Insects have a wide range of hearing. Some can hear ultrasonic sounds more than two octaves higher than people can hear. Other insects respond to sounds so low that the human ear cannot hear them. Yet only a few kinds of insects have true hearing organs, or "ears." These ears are located almost anywhere on the body, but never in the head. They consist simply of thin, flat membranes that vibrate when sound waves strike them, just as our eardrums do. Short-horned grasshoppers, locusts, cicadas, and many moths have their ears on the sides of the body. Long-horned grasshoppers and crickets have theirs on the front legs.

Most insects do not have ears. They hear by means of the delicate hairs on their antennae or elsewhere on the body. These hairs respond to sound waves, just as they do to other movements in the air. Male mosquitoes have long hairs on their antennae that cause the antennae to vibrate rapidly to sound waves. Some ants also hear by means of the hairs on their antennae. Cockroaches hear with the hairs on their *cerci,* the pair of feelers on the last segment of the abdomen. Caterpillars hear with hairs scattered over the whole body.

Although insects can hear, they do not have voices. Many of them make sounds by *stridulating*—rubbing

© David Scharf

The touch organs of a fruit fly, like those of other insects, consist chiefly of hairs and spines on most parts of its body. The picture above shows a magnified view of a fruit fly.

Walter Dawn

The "ears" of a cricket are on its legs. Each front leg has a drumlike membrane that vibrates when sound waves strike it.

Grant Heilman

The antennae of a male luna moth are covered with organs of smell that can pick up a female's scent over great distances.

one part of the body against another part. Grasshoppers, crickets, and cicadas are probably the noisiest insects. Usually, only the adult males stridulate. They "sing" to attract the females, most of which can make no sound. Short-horned grasshoppers stridulate by rubbing a hind leg against a vein in a forewing, much as a violinist draws his bow across the strings. Crickets sing by scraping their leathery front wings together. In Portugal, Japan, China, and some other countries, people keep crickets in cages for their cheerful songs. Cicadas have two drumheads on their abdomens, which they vibrate by means of muscles inside their bodies.

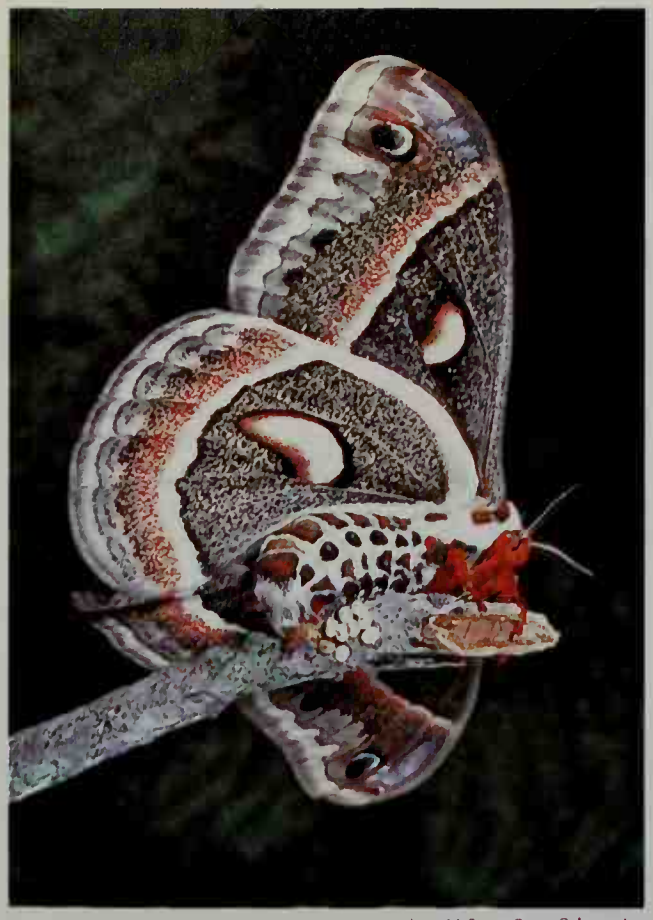
Many beetles also make sounds by scraping parts of their bodies together. In addition, they make whirring and buzzing noises with their wings. June beetles make sounds by blowing air out through their spiracles. The hum of flies and bees is made by the rapid vibration of their wings. Male mosquitoes are particularly sensitive to the notes given off by the beating wings of females, and will fly to the females to mate.

Touch. Insects are highly sensitive to touch, much more than people are. The touch organs consist of hairs and spines that cover all parts of an insect's body, even its eyes. The hairs are especially plentiful on the antennae. Any kind of pressure moves the hairs, setting up a nerve reaction that goes to the brain. Some of the hairs are so sensitive that the gentlest air current can bend them. No matter how carefully you move your hand toward a fly, the insect will dart off almost every time. Its hairs warn the fly that the air is being moved.

Taste. Many insects are sensitive to the same four taste sensations—sweet, sour, salt, and bitter—that people are. The tasting ability of insects varies among species. Some insects have an amazingly sharp sense of taste. For example, the amount of sugar in water that a monarch butterfly can taste would have to be increased 2,000 times before a person could taste it.

The taste organs of most insects are on their mouthparts. Some kinds of insects, including ants, bees, and wasps, also have taste organs on their antennae. They touch food with their antennae, and eat it if they like the taste. Other insects, including butterflies, some moths and flies, and honey bees, taste with their feet. They immediately extend the proboscis to feed if they step on something tasty. Some wasps and crickets have taste organs on the ovipositor, which they use to taste the places where they lay their eggs.

Smell. The sense of smell is located chiefly in the antennae of insects. Most species have a keen sense of smell. Insects use their sense of smell to locate food, to find their way about, and to locate places to lay their eggs. They also use it to recognize insects of their own kind and to find mates. Ants and bees recognize the members of their colony by their odor. Ants will drive away or kill an ant from another colony if it tries to enter their colony. But ants that normally fight one another will feed together peacefully if their antennae are removed. Male moths depend chiefly on their sense of smell to find mates. They can be attracted by the odor of a female moth more than 1 mile (1.6 kilometers) away. But they lose all interest in her if their antennae are removed.



Lynn M. Stone, Bruce Coleman Inc.

An egg is the starting point in every insect's life. A cecropia moth, *above,* lays her eggs on a twig. Caterpillars, which look completely different from the adult moths, hatch from the eggs.

The last molt of a cicada completes the insect's growth. The adult insect, *below,* crawls out of its final nymphal skin, shown still attached to a plant, with its wings fully developed.

Edward S. Ross

Every insect starts life as an egg. After hatching, the insect begins to grow and develop into an adult. During this process, most insects go through a series of fantastic changes in form. The entire cycle—from egg to adult—takes only a few days for some species and as long as 17 years for others. As adults, most insects live only a short time. Few kinds live more than a year. Adult mayflies probably have the briefest lives—only a few days or hours. On the other hand, queen termites may live more than 20 years. Among some species of insects, many generations are born and die in one year. Other species have only one generation a year.

Reproduction

Among most species of insects, a new individual is created when a sperm of the male fertilizes an egg of the female. The female receives the sperm during mating and stores them in her abdomen. Later, when she lays her eggs, the sperm enter the eggs as they leave her body.

Many insects have unusual ways of reproducing. Some cockroaches, flies, beetles, and other insects give birth to living young. The females keep the fertilized eggs inside their bodies until they hatch. Female aphids, gall wasps, thrips, and many other insects can reproduce without fertilization by the male. In fact, males are extremely rare or unknown among some species of insects. Some females, including queen honey bees, receive their lifetime supply of sperm during a single mating period. Thereafter, if the female fertilizes the eggs, only females will be born. If she does not fertilize them, only males will be produced.

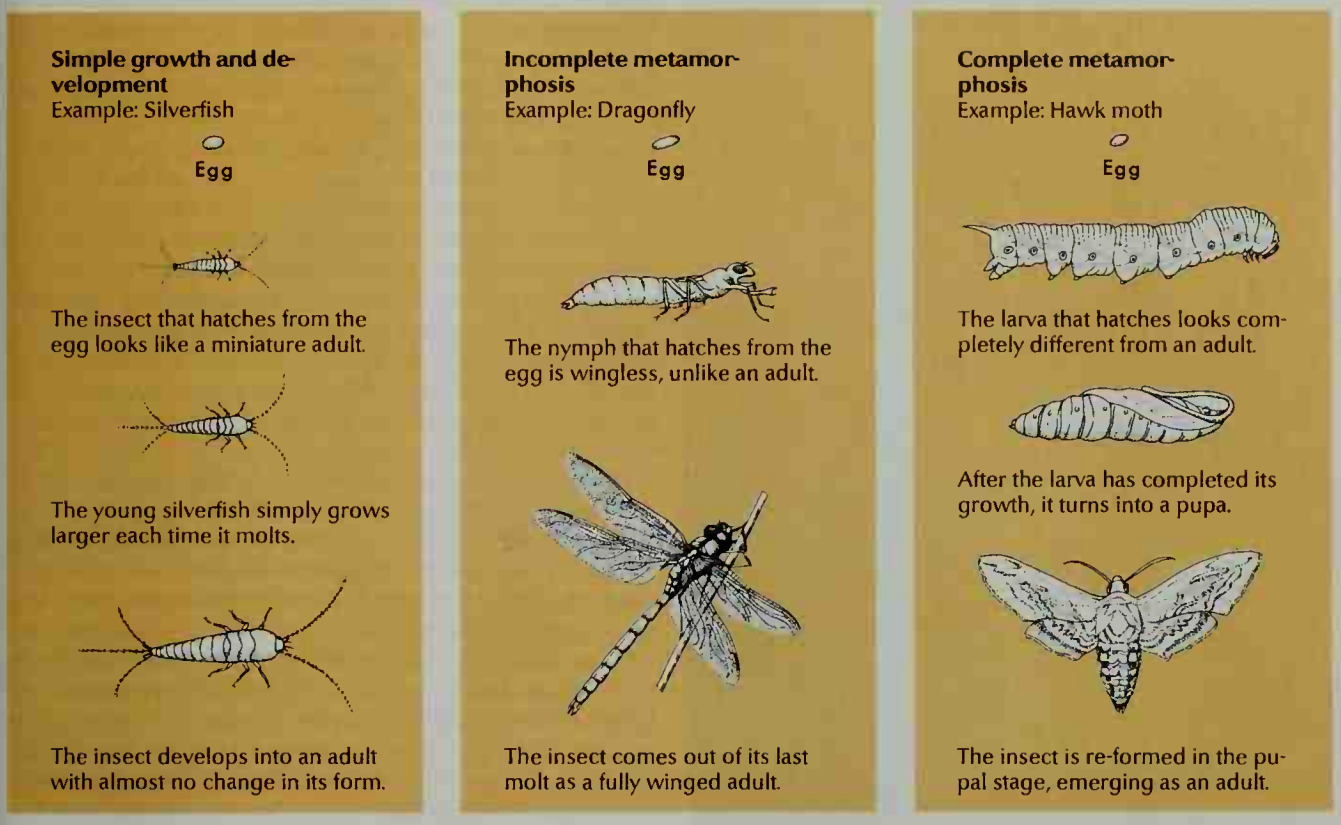
Insect eggs have a variety of shapes and color patterns, but most are oval or round and are white or cream colored. The eggs of the smallest insects can be seen only under a microscope. The largest insects lay eggs from one-fourth to one-half of an inch (6.4 to 13 millimeters) long. The number of eggs laid varies from one species to another. A female insect probably lays an average of 100 to 200 eggs during her lifetime. Some females lay only a few dozen eggs. Others may lay millions of eggs. Termites are the champion egg layers. After mating, some queen termites become helplessly swollen with eggs, which they produce at a rate of 10,000 to 30,000 or more a day. Insects lay their eggs singly or in batches. They usually deposit them on or near food, which the young feed on after they hatch.

There have been many stories about the tremendous reproductive ability of insects, and of what would happen if none of the young insects died. In four months, for example, a pair of house flies could produce about 190,000,000,000,000,000,000 descendants—if all of them lived. But this could not happen. Parasites, predators, the food supply, and other factors prevent such a population explosion among insects, just as they do among other animals.

Growth and development

After an insect hatches, it follows one of three patterns of growth and development, depending on its species. The simplest pattern occurs in a few kinds of primitive wingless insects, including silverfish and

The three patterns of insect growth and development



WORLD BOOK illustration by Marion Pahl

springtails. When these insects hatch, they look exactly like their parents, except for size. The young insects live in the same surroundings and eat the same food in the same way as the adults. They grow to adulthood by splitting the old exoskeleton when it becomes too tight and wiggling out of it. After the insects reach a certain size and their reproductive organs have fully developed, they can mate. From the time they hatch until they die, these insects change little, except to grow larger.

Other insects have a far different pattern of growth and development. The young look different from their parents, and are called *nymphs* or *larvae*. They change in form as they develop into adults. This change is called *metamorphosis*. An insect goes through one of two types of metamorphosis, incomplete or complete.

Incomplete metamorphosis occurs in such insects as chinch bugs, cicadas, cockroaches, damselflies, dragonflies, grasshoppers, and mayflies. These insects pass through three stages: (1) egg, (2) nymph, and (3) adult.

Among such insects as grasshoppers and chinch bugs, the nymphs look much like their parents, except that they have no wings. The wings first appear as little pads after the insect has shed its exoskeleton a few times. With each molt, the wings enlarge. After the last molt, the adult comes out with its wings fully developed. The nymphs usually live in the same places and eat the same food as the adults.

Among dragonflies and damselflies, the nymphs differ greatly from their parents. The adults are beautiful winged insects that spend much of their time in flight. The wingless nymphs live in water and breathe by means of gills. The nymphs are often called *naiads*. After they reach full growth, they crawl out of the water onto a plant stem or rock. They then shed their shells for the last time and become winged adults.

Complete metamorphosis takes place in most species of insects, including butterflies, moths, beetles, flies, bees, wasps, and ants. These insects go through four stages: (1) egg, (2) larva, (3) pupa, and (4) adult. The larvae of these insects are wormlike creatures that look completely different from their parents. Among many species, the larvae live in different places and eat different foods. They do not have their parents' compound eyes and wings. Most of them have chewing mouthparts, though their parents may have sucking mouthparts. Some larvae have no legs. Others may have many extra leglike structures on the abdomen. The larvae of many species have special names. For example, the larvae of butterflies and moths are called *caterpillars*; those of flies, *maggots*; those of beetles, *grubs*; and those of mosquitoes, *wrigglers*. Larvae simply eat and grow, molting several times as their skin becomes too tight. In one day, a caterpillar may eat several times its weight in leaves.

After a larva completes its growth, it stops eating. It then becomes a pupa. In preparation for this stage, some larvae spin a cocoon or form some other protective covering around their bodies. Most pupae lie quietly and appear lifeless. But inside the protective covering there is great activity. The larval structures are being broken down—largely into a liquid—and re-formed into adult organs. After the change is complete, the pupal covering cracks open and the adult insect crawls out. See Metamorphosis.

Ross E. Hutchins

The water boatman, like other aquatic insects, has adapted itself in many ways to living in water. The insect has long, flat hind legs that serve as oars. It eats algae and bottom slime.

An insect's life is filled with danger. The insect may be eaten by another insect, a bird, or some other animal. People may crush, burn, or poison it. A parasite may feed on it, or a disease may strike it. A dry spell may wither the plants on which the insect feeds, causing it to starve. Cold weather may kill it. And if the insect and too many others of its species survive these dangers, their food supply will run out—and the insect will die anyway.

Insects have developed many ways of life in their endless battle for survival. They have adapted themselves to almost all kinds of living conditions, and have developed many ways to outwit their enemies. Many species depend almost entirely on their high rate of reproduction to survive the hazards of life. In fact, most insects spend most of their time eating and reproducing. Almost everything else they do is related to those two activities.

Courtship. Insects attract mates in many ways. Among many kinds of moths, the females give off an odor that attracts males, often across long distances. The males of many species of butterflies also have scent organs that they use to attract females. Male grasshoppers, crickets, cicadas, and katydids "sing." Male tree crickets also give off a liquid from behind their wings, which the females feed on. Male dance flies usually bring the females gifts of captured insects. Among some species of fireflies, the females give off a flashing light in the form of code signals to attract males. The males of some other species flash their light and then wait for the females to give an answering flash.

Family life. Most kinds of insects have no family life. The parents get together only to mate. The females simply lay their eggs where the developing young will have food, and then leave them. Many wasps and bees store food with their eggs. Parasitic wasps and flies lay their eggs on or near other insects or animals. The horse botfly glues her eggs to the hairs of a horse where they

WORLD BOOK photo by Don Stebbing

A firefly flashes its light on and off as a mating signal. Not all species of fireflies produce light. Among the species that do, each has its own characteristic flashing pattern.

J. R. Simon, Bruce Coleman Inc.

The ichneumon wasp drives its long ovipositor into wood and deposits its eggs in the larvae of wood-boring insects. The ichneumon larvae then hatch and develop inside the other insects.

can be licked off by the horse. The larvae grow and develop in the horse's stomach, and are discharged with waste matter. The females of a number of species give their eggs or young some care. Earwigs keep their eggs clean, guard them until they hatch, and then watch over the young. A few kinds of beetles and bugs also stay with their young after they are born, guarding and feeding them.

Only the true *social insects* have a real family life. All termites, all ants, many bees, and some wasps are social insects. They live in organized communities in which the members depend on one another. These communities are really overgrown families. For example, the 60,000 to 80,000 bees in a hive are all the offspring of one queen. So are the millions of termites that may make up a termite colony. The queen's job is simply to lay eggs. The adults in the colony feed and care for the young. Most of the adults cannot reproduce, and are called *workers.* Termites have both male and female workers, and there is also a permanent reproductive male, or "king," in each termite colony. But all the workers among ants, bees, and wasps are females. These insects have males in their colonies only at certain times. The males' only job is to mate with the queen, after which they soon die. The workers in a colony have different tasks. *Nurses* look after the young, and *soldiers* defend the colony from attacks by enemies. Some workers search for food, and others enlarge and clean the nest.

Ants are probably the most successful social insects. They have developed many different ways of life. Some kinds of ants keep aphids or other insects, which the ants "milk" for their sweet liquid. Harvester ants collect seeds and store them in their nests. Some other species actually grow their own food by cultivating tiny mushroom gardens in their nests. Thief ants live by stealing food from other ants. Many ants raid other ants' nests and carry off the young, which they bring up as slaves.

Edward S. Ross

Ant "dairy farmers" tend a "herd" of aphids. As the ants gently stroke the aphids on the back with their antennae, the "cows" release a liquid called *honeydew,* which the ants lap up.

Edward S. Ross

A honey bee colony is an organized community. All the members—workers, drones, and queen—have their special jobs. The red bee is the queen. The beekeeper dyed her for identification.

Edward S. Ross

A swarm of ladybugs gathers to hibernate. In fall, many species of ladybugs migrate from their summer feeding grounds to sheltered places, where they hibernate together in great masses.

Army ants live chiefly by hunting other insects. They march across the land by the hundreds of thousands, eating all the insects they meet. They also attack mice, lizards, or any other animal that they can surround through a series of flanking movements. If the animal cannot escape through the encircling wall of ants, it is quickly torn to bits.

Social insects communicate with one another by the use of sound, touch, and scent. Honey bees use a dance to tell other members of the hive the direction and distance of a food supply.

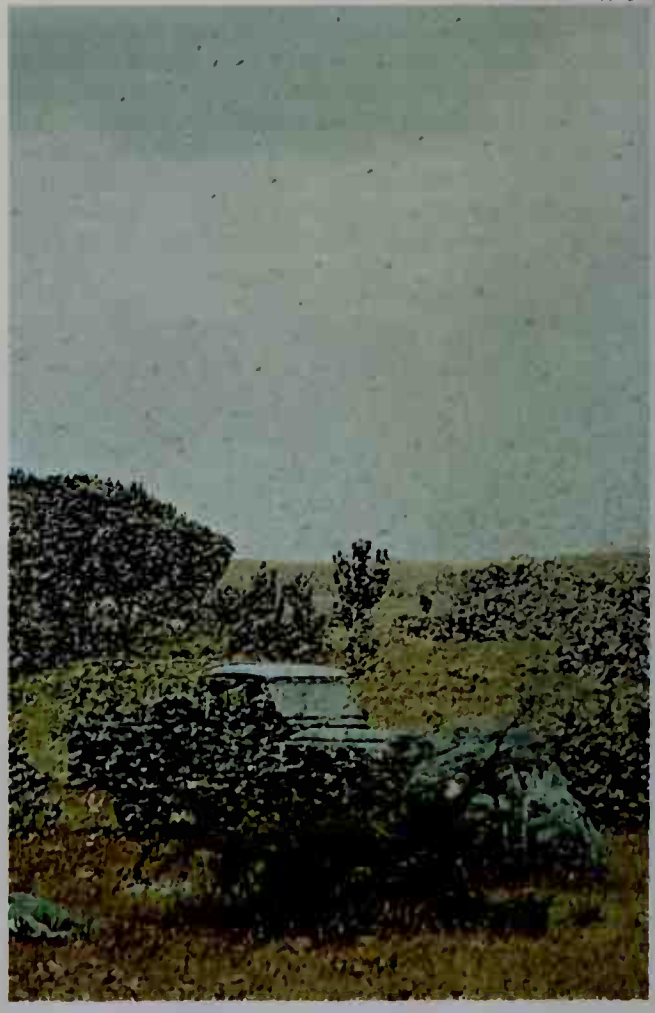
Hibernation and migration. Many insects die when winter approaches. But many others live through the cold by hibernating in the egg, larval, or pupal stage. A number of adult insects, including house flies, mosquitoes, ladybugs, and some moths and butterflies, also hibernate. They spend the winter in barns, cellars, attics, caves, holes in trees, burrows in the ground, or other protected places.

Every fall, North American monarch butterflies gather in great clouds and fly south to spend the winter in tropical or subtropical areas. In spring, they drift northward again, laying eggs as they go. Few of them live long enough to complete the return trip. Their offspring, after becoming adults, continue the northward journey. Painted ladies and several other species of butterflies also migrate with the seasons, as do certain species of moths.

Many other insects also make long migratory flights. The most famous are probably the locusts. They often travel in swarms so huge that they black out the sun. Scientists do not know why locusts migrate, except that they do so after building up an enormous population. Locusts do not migrate because they are hungry. In fact, they may leave a land of plenty and not stop to feed during most of their long flight. But after they settle down, they destroy every bit of plant life.

Desert locusts swarm around the motor vehicle of an African antilocust organization. A swarm may consist of billions of locusts and cover 2,000 square miles (5,200 square kilometers).

Anti-Locust Research Centre, British Crown Copyright



Ross E. Hutchins

Chemical weapons give many insects a powerful defense against their enemies. The saddleback caterpillar has sharp hairs that break when they pierce the skin, releasing a poison.

Edward S. Ross

Protective resemblance helps many insects deceive their enemies. The measuring worm, the caterpillar of a moth, can hold itself stiff and almost erect—and look amazingly like a twig.

Protection from enemies. Insects have many means of self-defense against their enemies. Most simply try to escape, and quickly fly, leap, or scamper away. Many caterpillars and beetles play dead, or they adopt a threatening posture that may frighten an enemy.

A great number of insects have powerful weapons for defense. Some can wage chemical warfare. Bombardier beetles, earwigs, walkingsticks, cockroaches, and many other insects use a harmful spray against their enemies. Stink bugs, lacewings, and carrion beetles give off foul odors. Some ants, stag beetles, and other insects have powerful jaws that can pinch painfully. Bees, wasps, and some ants have poisonous stings. Some caterpillars have hollow hairs filled with poison. These hairs break at the slightest touch, releasing the poison. Some butterflies, moths, and other insects are protected simply because they taste bad to birds or other predators.

Many insects escape from their enemies because their color or form blends with their surroundings. When resting on tree trunks, many moths look like bark or bird droppings. Walkingsticks and many caterpillars resemble twigs. When a leaf butterfly's wings are folded, the insect looks like a dead leaf.

Some insects with such powerful defensive weapons as stings or chemical sprays have bright color patterns. For example, many bees and wasps have yellow and black stripes. No animal that has attacked one will want to try again. The warning colors make it easy for predators to remember that these insects are dangerous.

Many insects that do not have protective devices resemble those that do, and their enemies are deceived and avoid them. Such insects are called *mimics*. Common mimics include certain hover flies, beetles, and drone flies that look like bees or wasps. The most famous mimic in North America is the viceroy butterfly, which resembles the monarch butterfly. Birds leave the viceroy alone because the monarch tastes unpleasant to them. Some well-protected insects even resemble other well-protected insects. Many unrelated wasps have the same black and yellow bands on their abdomens. By mimicking each other, protected insects gain even more protection. See **Protective coloration; Mimicry.**

Mimicking protected insects gives unprotected insects a chance to outwit their foes. A stingless syrphid fly, *below left,* mimics the colors and patterns of a stinging wasp, *below right.*

Edward S. Ross

Edward S. Ross

A fierce battle is about to begin, *above,* as a female wasp called a tarantula hawk approaches her dangerous prey—a tarantula. During the struggle, the tarantula is rolled over on its back. The wasp then plunges her poisonous sting into the soft underside of the spider, which goes limp, *below.* She drags her paralyzed victim, *bottom picture,* to a nest, where she will lay an egg on it.

Why insects behave as they do. The lives of most insects are too short for the young to learn from their parents. In many cases, the adults have died by the time the young are born. Yet a young insect does not have to be taught what to do. The insect's behavior patterns are inherited and built firmly into its nervous system. Every insect reacts automatically to its surroundings. If a lamp is turned on, a moth will fly toward it, but most cockroaches will run for cover. The odor of overripe fruit attracts fruit flies, and the heat given off by warm-blooded animals attracts fleas.

Insects often appear to be intelligent and to know what they are doing. When a female solitary wasp is ready to reproduce, for example, it looks for the right place to build a nest. After the nest has been built, it searches for the proper prey—usually a spider or caterpillar. Using its poisonous sting, the wasp paralyzes the victim and carries it to the nest. The wasp then lays an egg on the prey, which the larva will feed on after the egg hatches. Finally, the female seals and camouflages the nest. The wasp does all this automatically. It does not have to learn how.

Insects do have some ability to learn. A honey bee can learn to associate a color with food, and to recognize landmarks around its hive. But generally, each insect of each species acts entirely according to its inherited behavior patterns. These patterns, like the insect's body structures, have developed through the centuries in the struggle of the species to survive. E. W. Cupp

The orders of insects

Insects belong to the phylum *Arthropoda,* a basic division of the animal kingdom that also includes centipedes, crabs, and spiders. The phylum is divided into several classes. Insects make up the class *Insecta.* This class is further divided into orders of insects according to various characteristics. Such characteristics include the presence or absence of wings, the structure of the wings and mouthparts, and the type of metamorphosis.

Entomologists do not agree on the number of insect orders. This section lists orders for all major insect groups. The orders are arranged according to the evolutionary development of insects. Orders of primitive wingless insects whose structure and habits have changed little over time are at the beginning of the list. The most highly developed orders appear at the end, though it is difficult to say which orders are the most specialized.

The first insects were wingless and appeared at least 400 million years ago. They may have evolved from wormlike creatures or from animals with lobelike legs. By about 300 million years ago, many insects had developed wings. Some early insects were immense. One species of dragonfly had a wingspread of at least 2 feet (61 centimeters). By the beginning of the Cretaceous Period, about 145 million years ago, all present-day insect orders had appeared.

Order and common names	Characteristics of adults and type of metamorphosis	Example
1. **Collembola** Springtails	Chewing or piercing-sucking mouthparts that are withdrawn into head; wingless; long antennae; reduced compound eyes or none; most species have a forked springing organ on abdomen with which they jump; no metamorphosis.	 **Springtail**
2. **Protura** Proturans	Piercing-sucking or chewing mouthparts that are withdrawn into head; wingless; only insects with no antennae; no eyes; front legs used as organs of touch, and carried upright like antennae; no metamorphosis.	 **Acerentomon**
3. **Diplura** Campodeids, japygids	Chewing mouthparts that are withdrawn into head; wingless; long, slender antennae; no eyes; short or long cerci; cerci of some species modified to form a pair of pincers, used in catching prey; no metamorphosis.	 **Campodeid**
4. **Thysanura** Bristletails, silverfish	Chewing mouthparts; wingless; long, slender antennae; compound eyes reduced or absent in some species; usually scaly body; two or three bristlelike tails; run swiftly or jump when disturbed; no metamorphosis.	 **Silverfish**
5. **Ephemeroptera** Mayflies	Reduced chewing mouthparts; usually two pairs of membranous wings, held above body when at rest; hind wings much smaller than front wings; very short antennae; large eyes; two or three long tails; adults do not eat and are short lived; aquatic nymphs; incomplete metamorphosis.	 **Mayfly**
6. **Odonata** Damselflies, dragonflies	Chewing mouthparts; two pairs of equal-sized, transparent, and membranous wings that cannot be folded; very small antennae; huge eyes; strong fliers; cannot walk, but legs used to catch prey in air; mate in flight; aquatic nymphs predatory; incomplete metamorphosis.	 **Dragonfly**
7. **Plecoptera** Stoneflies	Chewing mouthparts, often reduced; two pairs of membranous wings, folded flat over body when at rest; hind wings larger than front wings; long antennae and cerci; aquatic nymphs; incomplete metamorphosis.	 **Stonefly**
8. **Dermaptera** Earwigs	Chewing mouthparts; wingless or two pairs of wings; front wings short and leathery; hind wings large and membranous, folded under front wings when at rest; forceps on tip of abdomen; incomplete metamorphosis.	 **Earwig**
9. **Orthoptera** Crickets, grasshoppers, locusts	Chewing mouthparts; two pairs of wings; front wings narrow and leathery; hind wings broad and membranous, folded under front wings when at rest; medium to long antennae; some species wingless; some species have "ears" and make sounds by stridulating; incomplete metamorphosis.	 **Grasshopper**
10. **Isoptera** Termites	Chewing mouthparts; reproductives have two pairs of similar, membranous wings, held flat over body when at rest; wings shed after mating flight; workers, soldiers wingless; incomplete metamorphosis.	 **Termite**
11. **Mantodea** Mantids	Chewing mouthparts; two pairs of wings; front wings narrow and leathery; hind wings broad and membranous, folded under front wings when at rest; short antennae; forelegs often held in an upraised position that makes the insect look as if it is praying, hence the common name "praying mantis"; incomplete metamorphosis.	 **Mantid**
12. **Blattaria** Cockroaches	Chewing mouthparts; two pairs of wings; leathery front wings; broad, membranous hind wings that are folded; wings may be reduced in size or absent; medium to long antennae; head concealed by a flap that projects over it; incomplete metamorphosis.	 **Cockroach**

Continued on next page.

Order and common names	Characteristics of adults and type of metamorphosis	Example
13. Phasmatodea Walkingsticks	Chewing mouthparts; two pairs of wings or wingless; leathery front wings and membranous hind wings; medium to long antennae; body shape and color resemble leaves and twigs for camouflage; incomplete metamorphosis.	 **Walkingstick**
14. Embioptera Webspinners	Chewing mouthparts; females and some males wingless; most males have two pairs of membranous wings, held flat over body when at rest; forelegs have silk-spinning organs; incomplete metamorphosis.	 **Webspinner**
15. Psocoptera Barklice, booklice, psocids	Chewing mouthparts; two pairs of membranous wings, roofed over back when at rest; front wings larger than hind wings; some species wingless, of which booklice are best known; incomplete metamorphosis.	 **Booklouse**
16. Mallophaga Chewing lice	Chewing mouthparts; wingless; reduced eyes or none; parasites of birds and a few mammals; feed on feathers, hair, and skin; pest of domestic animals, especially poultry; incomplete metamorphosis.	 **Chicken louse**
17. Anoplura Sucking lice	Piercing-sucking mouthparts that can be withdrawn into head when not in use; wingless; short antennae; reduced eyes or none; short, clawed legs; parasites that suck blood of mammals; incomplete metamorphosis.	 **Human body louse**
18. Thysanoptera Thrips	Piercing-sucking mouthparts; two pairs of wings fringed with long hairs; wings fold flat over body when at rest; some species wingless; short antennae; females of many species can reproduce without mating; males unknown in some species; incomplete or complete metamorphosis.	 **Pear thrips**
19. Hemiptera Bugs, aphids, cicadas	Piercing-sucking mouthparts; one or two pairs of wings or wingless; wings folded flat or roofed over the body when at rest; incomplete or complete metamorphosis.	 **Cicada**
20. Neuroptera Ant lions, lacewings	Chewing mouthparts; two pairs of similar, membranous wings, covered with many veins; wings roofed over body when at rest; long, slender antennae; most larvae and adults are predatory; complete metamorphosis.	 **Ant lion**
21. Coleoptera Beetles	Chewing mouthparts; two pairs of wings; front wings modified into thick, horny wing covers; hind wings membranous, folded under front wings when at rest; some species wingless; complete metamorphosis.	 **Scarab**
22. Strepsiptera Strepsipterans	Reduced chewing mouthparts; males have one pair of membranous hind wings; front wings reduced to clublike parts; females of parasitic species lack antennae, eyes, wings, legs; many species live in other insects; complete metamorphosis.	 **Stylops**
23. Hymenoptera Ants, bees, sawflies, wasps	Chewing or chewing-lapping mouthparts; two pairs of small, stiff, and membranous wings that interlock in flight; front wings larger than hind wings; worker ants and a few other insects wingless; most species solitary, but many have social behavior; complete metamorphosis.	 **Bumble bee**
24. Trichoptera Caddisflies	Reduced chewing mouthparts; two pairs of hairy, membranous wings, roofed over body when at rest; long antennae; aquatic larvae live in cases of silk and debris; adults eat liquid food; complete metamorphosis.	 **Caddisfly**
25. Lepidoptera Butterflies, moths	Sucking mouthparts shaped like a coiled tube when not in use; two pairs of scaly, usually broad, wings; front wings usually larger than hind wings; long antennae; large eyes; complete metamorphosis.	 **Monarch butterfly**
26. Mecoptera Scorpionflies	Chewing mouthparts; two pairs of long, slender, and membranous wings, laid flat or roofed over body when at rest; some species wingless; long, slender antennae; large eyes; long legs; tip of abdomen of some males curved like a scorpion's tail; complete metamorphosis.	 **Scorpionfly**
27. Siphonaptera Fleas	Piercing-sucking mouthparts; wingless; body flattened from side to side; simple or no eyes; long hind legs adapted for jumping; parasites that suck blood of birds and mammals; complete metamorphosis.	 **Cat flea**
28. Diptera Flies, midges, mosquitoes	Piercing-sucking or sponging mouthparts; front wings transparent; hind wings replaced by short, knobbed structures called *halteres*, which serve as balancing organs; large eyes; complete metamorphosis.	 **House fly**

Related articles. See **Beetle; Fly**; and Moth with their lists of *Related articles*. See also the following articles:

Other insects

Ant
Ant lion
Aphid
Bed bug
Bee
Boxelder bug
Bug
Bumble bee
Butterfly
Chinch bug
Cicada
Cockroach
Cricket
Dragonfly
Earwig
Flea
Grasshopper
Head lice
Hellgrammite
Hornet
Ichneumon wasp
Katydid
Lacewing
Leaf insect
Leafhopper
Locust
Louse
Lovebug
Mantid
Mayfly
Mole cricket
Mormon cricket
Phylloxera
San Jose scale
Sawfly
Scale insect
Scorpionfly
Silverfish
Stink bug
Stonefly
Termite
Thrips
Walkingstick
Wasp
Water bug
Yellow jacket

Life changes

Caterpillar
Chrysalis
Cocoon
Grub
Larva
Maggot
Metamorphosis
Pupa

Other related articles

Animal
Arthropod
Bioluminescence
Bird (The importance of birds)
Classification, Scientific
Compound eye
Disease (Spread of infectious diseases)
Entomology
Forestry
Frisch, Karl von
Insecticide
Linnaeus, Carolus
Mimicry
Molting
Parasite
Pheromone
Plant (Insect-eating plants)
Pollen
Protective coloration
Swammerdam, Jan
Virus (How viruses are used)

Outline

I. The world of insects
A. The variety of insects
B. Why insects are so successful
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B. Harmful insects
C. Insect control
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VI. The ways of life of insects
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B. Family life
C. Hibernation and migration
D. Protection from enemies
E. Why insects behave as they do
VII. The orders of insects

Questions

What are the body features that all species of insects have in common?
Why can many insects walk, mate, and lay eggs even though their heads have been cut off?
How long do most adult insects live?
What are some ways in which insects are beneficial and harmful to human beings?
Why does a growing insect shed its exoskeleton?
Which insects are probably the fastest fliers? How fast can they fly?
How do insects hear? How do they make sounds?
What are some ways in which insects protect themselves from their enemies?
How do spiders differ from insects?
What are some reasons for the success of insects in their struggle for survival?
What body structure helps insects smell? How do they use their sense of smell?
What are the three patterns of insect growth and development? How do they differ?

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Insecticides are used to control insect pests that damage plants. Farmers use airplanes to spray large fields of crops with insecticides. Such spraying is called *crop-dusting.*

Insecticide is a substance that kills insects. In the United States, insects cause billions of dollars a year in crop and livestock losses. They also harm human health by transmitting diseases.

Farmers and gardeners use insecticides to protect plants and animals. Apple trees must be sprayed, or many of the apples will be "wormy" with moth *larvae* (young). Cotton fields may also be sprayed with insecticide, or boll weevils or other insects might damage the crop so badly that cotton farmers can make no profit. Many livestock owners spray their livestock or dip them in an insecticide solution to protect them from flies, lice, mites, and ticks. These pests spread such diseases as cattle fever and sheep scab. Diseases such as malaria and typhus can be controlled by using insecticides to treat the breeding places of the insects that spread the diseases. Insecticides are also used in homes to control such insects as ants, fleas, and cockroaches.

Some insecticides are called *stomach poisons* because they kill insects that eat them. Others are called *contact poisons.* They kill insects that touch them. *Systemics* are insecticides that can be sprayed on or injected into plants and animals. The plants and animals absorb the insecticide. Then, when an insect bites the treated plant or animal, it dies. *Fumigant* insecticides form vapors and gases that kill insects. *Chemosterilants* make insects unable to reproduce. Some insecticides act in more than one way. For example, a contact poison may also be a stomach poison.

Types of insecticides

Insecticides are usually classified according to how they are made. They are classed as organic, inorganic, botanical, and microbial insecticides.

Organic insecticides are the most widely used. They are synthetic substances consisting mainly of carbon, hydrogen, and oxygen atoms. Hundreds of organic insecticides are available. The three main types are chlorinated hydrocarbon insecticides, organic phosphate insecticides, and carbamate insecticides.

Chlorinated hydrocarbon insecticides, sometimes called *organochlorines,* contain chlorine atoms. They are used to control a variety of insects that affect plants and animals. Chlorinated hydrocarbon insecticides include DDT, chlordane, lindane, and methoxychlor. These substances are considered *persistent* (long-lasting) because once used they can affect living things for several years. Persistent insecticides have been blamed for killing birds, fish, and other animals. As a result, they are being replaced by other insecticides.

Organophosphate insecticides contain phosphorus atoms. They can be used on food crops because they do not leave harmful deposits in foods. However, some organophosphates must be handled carefully because they are highly poisonous to people. One of these, called parathion, provides excellent protection against mites and *aphids* (plant lice) on cotton, fruit trees, and vegetables. Malathion is less dangerous to apply and is widely used by farmers to protect against many insects. It is also commonly used to control mosquitoes.

Carbamate insecticides contain one or more *amino groups,* which are made up of one nitrogen atom and two hydrogen atoms. Carbamates can be used to kill most insects. They do not leave harmful deposits on food. However, some carbamates are harmful to warm-blooded animals.

Inorganic insecticides are usually made from minerals. They include calcium arsenate, lead arsenate, fluorides, and lime sulfur. Various inorganic insecticides protect cotton, fruit trees, vegetables, and livestock, but several of them are persistent. To reduce the danger of contamination in animals and people, these persistent insecticides are being replaced by inorganic substances that break down more quickly.

Botanical insecticides are made from plants. Nicotine from tobacco leaves makes a powerful insecticide against aphids. Dried pyrethrum flowers produce an insecticide that can be used around food, pets, and livestock to protect against flying or crawling insects. *Rotenone* is a poisonous substance found in the roots of the derris and cube plants, which grow in Asia and South America. It is used against cattle grubs and lice, and against garden insects. It is also used to kill unwanted fish when cleaning out lakes.

Microbial insecticides infect insects with diseases. They have been used against Japanese beetles and some types of caterpillars. Most insecticides are useful against many kinds of insects, but a microbial insecticide that kills one kind may be harmless to another.

Applying insecticides

Insecticides may be sprayed, dusted, used in a dipping tank, injected, or mixed with insect food.

Spraying and dusting. For spraying, an insecticide is mixed with an oil or solvent, or with solvent and an *emulsifier* (soaplike material). When mixed with water, the insecticide forms a creamy white liquid. Many household pest insecticides are packaged in pressurized *aerosol* cans for easy spraying.

Dusting powders are formed by mixing the insecticide with powdered clay. Sometimes an emulsifier is added, and the insecticide is mixed with water so it can be sprayed. The water evaporates after the plant is sprayed, leaving a fine layer of dust.

Injection is a costly and difficult method of applying insecticides. Only a few chemicals are suitable for injection into plants or animals. Only trained people should inject these chemicals. Bait insecticides are mixed with sugar, seeds, or other insect foods.

Dangers of insecticides. People applying insecticides should wear protective clothing to avoid accidental poisoning. Insecticides must be chosen carefully, because the wrong kind may kill or injure the plant or animal being treated. Substances that leave harmful deposits should not be used excessively on food crops. Instructions on insecticide containers describe how to use the products safely.

Insecticides should be applied carefully to avoid killing such useful insects as honey bees. Some people use insecticides that kill only one type of insect so that others will not be harmed. They also use insecticides that do not affect warm-blooded animals. During the 1960's, many people became concerned over the amount of persistent insecticides being used and their effect on animals and people. In 1972, the U.S. government began to gradually phase out all uses of DDT, and in 1975 it banned most uses of chlordane. Nearly all uses of ethylene dibromide (EDB) as a fumigant insecticide were banned in 1983. The U.S. government banned many uses of the organophosphate chlorpyrifos, sold under the trade names Dursban and Lorsban, in 2000.

Harold D. Coble

Related articles in *World Book* include:

Aerosol	Fumigation	Nicotine
Arsenic	Fungicide	Pest control
Carson, Rachel	Hellebore	Pheromone
DDT	Insect (Insect control)	Pyrethrum
Environmental pollution		Rotenone

Insectivore, *ihn SEHK tuh vawr,* is the name of any one of a group of small mammals, such as the mole, which feed chiefly on insects. They are found in all parts of the world except Australia. See also **Hedgehog; Mole; Shrew; Solenodon.** Hugh H. Genoways

Scientific classification. Insectivores belong to the class Mammalia. They make up the order Insectivora.

Insectivorous plant. See **Carnivorous plant.**

Inside Passage is a water transportation route from Seattle, Washington, to the Alaskan towns of Haines and Skagway. The passage extends about 1,000 miles (1,605 kilometers) between off-shore islands and the coasts of British Columbia and Alaska. It extends northward from Seattle through the straits of Georgia, Discovery Passage, Johnstone, and Queen Charlotte to Fitzhugh Sound, Princess Royal Channel, Grenville Channel, Chatham Sound, Revillagigedo Channel, and Clarence Strait. Ships following the route pass Admiralty Island by way of either Chatham Strait or Stephens Passage. From there, the Lynn Canal leads to Haines and Skagway. Very high rainfall, frequent coastal fogs, and such navigational hazards as sharp turns make steering the passage difficult, but the route offers spectacular scenery. See also **Alaska** (Places to visit); **British Columbia** (Places to visit).

John Edwin Coffman

Insignia, *ihn SIHG nee uh,* are emblems of metal or cloth worn by a person in uniform. These emblems identify the wearer's rank or grade, branch of service, duty assignment, or honors. Insignia may also take the form of a wound stripe, a length-of-service stripe called a "hash mark," or a *fourragère,* a braided cord looped over the shoulder.

Officers in the United States Army and United States Air Force wear insignia of rank on each shoulder, in the form of small gold or silver bars, oak leaves, eagles, or stars. Army officers wear branch-of-service insignia on blouse lapels, and, on some uniforms, insignia of rank and branch of service on their shirt collars. Enlisted personnel of both services wear cloth chevrons on both arms as insignia of rank. In the Army, they wear metal branch-of-service insignia on their blouse lapels. Army engineer officers wear distinctive buttons bearing the motto *Essayons,* meaning *Let us try.* United States Army insignia date from 1775, when George Washington directed militia officers to wear colored rosettes on their hats to indicate rank.

Naval officers wear gold stripes on their cuffs or shoulder boards. On some uniforms, they wear miniature metal insignia, like those of Army officers, on their shirt collars. The insignia of rating for enlisted personnel are short diagonal stripes on the upper left sleeve. The petty officers' insignia of rating, an eagle and chevrons, also appear on the upper left sleeve. The specialty insignia are located between the eagle and chevrons.

The Western world's use of insignia probably started in 1097, when the Crusaders besieging Antioch used shield symbols for identification. Later, barons adopted insignia as family coats of arms and orders of knighthood. These emblems included heavily jeweled necklaces, medals studded with precious stones, and other elaborate ornaments. The Order of the Garter has a dark blue velvet garter as part of its insignia. Thomas E. Griess

See also **Knighthood, Orders of;** also the pictures in **Air Force, U.S.; Army, U.S.; Canada, Armed Forces of; Marine Corps, U.S.; Navy, U.S.**

Insolvency. See **Bankruptcy.**

Insomnia, *ihn SAHM nee uh,* is the inability to sleep naturally. Nonmedical people often speak of it as though it were an illness in itself. Doctors, however, know that insomnia is a *symptom* (sign of an illness) that may result from any one of a number of causes. Pain or discomfort from a physical illness will interfere with sleep. Coffee or other stimulants to the nervous system can cause insomnia. Certain drugs affect the brain in such a way as

to produce wakefulness. Some serious sleep diseases, such as sleep apnea, can also produce insomnia.

In addition, insomnia may be caused by psychological factors. It is often obviously related to conscious fears and worries, as for example when sleep is disturbed by frightening dreams. Everyone has occasional insomnia of this sort. Insomnia may also be a symptom of mental illness, either mild or severe. Ernest Hartmann

See also **Sedative; Sleep; Sleep apnea.**

Inspector General is a fact-finding officer of an Inspector General's department. Inspector Generals' departments are found in all United States military branches and in many other U.S. government agencies. In the U.S. Army, individual officers or teams of officers from the Army's Inspector General's department make frequent visits to all Army installations to make sure that Army regulations are being followed. The officers investigate conditions of discipline, morale, training, property and money accounting, record keeping, and all other matters that affect the efficiency and economy of the Army. Enlisted personnel may make complaints to these officers at any time about food, treatment by superior officers, or other conditions. Allan R. Millett

Inspiration. See **Respiration.**

Installment plan is a method of buying on credit. A store which sells goods on the installment plan usually requires that the buyer pay part of the price of an article at the time of the sale. The buyer then must pay equal parts of the remainder at stated times thereafter, until the bill is paid in full. These payments are called *deferred payments,* and may be extended over varying periods of time.

How the plan works. The usual method of buying a car on the installment plan is as follows. A family buys a car from a dealer for a *cash price* of $12,000, for example. But when they ask for time payments, they must pay a *finance charge* in addition to the cash price. These charges vary according to the risk involved, the length of time the installments cover, and several other factors. In this example, the finance charge may be $2,200. The family must actually pay $14,200 for their car.

The buyer normally makes a *down payment* of one-fourth of the cash price, in this case $3,000. The buyer must then pay $11,200 in installments. This is called the *total time price.* The dealer normally *discounts* the bill by selling it to a finance company that pays the dealer the remaining $9,000 due on the car (see **Finance company**). The finance company collects this $9,000 plus the $2,200 finance charge directly from the buyer. The debt is divided into equal monthly payments. If the contract calls for 48 monthly payments, the family pays $233 a month. If the family fails to make a payment, the finance company may cancel the payments and claim the car.

The finance charge ($2,200 as above) covers interest on money that the finance company obtains from sale of stock, from reinvestment of earnings, or from long- or short-term creditors. By transferring the installment payments to the finance company, the dealer makes what practically amounts to a cash sale. The dealer avoids investment in *receivables,* or accounts due, and is able to carry on a larger volume of business.

There are several varieties of the installment plan. Great Britain uses a *hire purchase* system. The buyer literally borrows an article and pays monthly installments as a sort of rent. After a certain number of installments have been paid, the person may buy the article for a fraction of the total rent obligation. The rents are subtracted from the purchase price, but finance and insurance charges are added.

Great Britain and other countries have *credit checks.* The credit check is used to purchase articles at certain stores. After a down payment, the credit check is paid for on the installment plan. The difference is that the credit check is actually bought before the purchases are made. Australia has a similar check, called a *cash order,* which is used in the same way.

History. Records show that some homes in ancient Rome were bought on the installment plan. At the beginning of the 1800's, a furniture company in New York started an installment plan. Several other companies followed. In 1916, the new automobile industry caught up the idea. A few years later the plan had spread to many other industries. Today many articles with resale value are paid for under the installment plan. Such goods include automobiles, farm machinery, furniture and home appliances, and homes. Frederick E. Webster, Jr.

Instinct is a term used to categorize behavior that appears to develop largely independent of experience. Instinctive behaviors are determined by the genetic makeup of the organism. They differ from *learned behaviors,* which gradually develop as a result of experiences by the organism in its environment. Although behaviors may be categorized as instinctive or learned for ease of discussion, few behaviors, if any, are all one type or the other. Behaviors develop as a result of the interaction of genetic and environmental influences, but some may be affected more by genetic factors, and others more by experience.

The mating behavior of a fish called the three-spined stickleback includes many examples of instinctive behavior. The male stickleback chooses a mating area and drives other fish from it. He then collects plants and forms them into a small mound. He wriggles through the completed mound, creating a tunnel. This tunnel, which is slightly shorter than the fish, becomes his nest. Meanwhile, his normally dull-colored body has changed color. His belly becomes bright red and his back bluish-white. He then starts to court females. Whenever a female, her abdomen swollen with eggs, enters his mating area, he swims toward her and performs a zigzagging "dance." He continues this dance until a female follows him to his nest, where she lays her eggs. The female then swims away, and the male fertilizes the eggs. He stays near the nest to protect the eggs and, later, the young.

The stickleback does not learn the basics of his complicated mating ceremony. Each male is born with the basic pattern built into his nervous system, and all male sticklebacks perform essentially the same actions.

Most behavior that would be called primarily instinctive is relatively rigid and does not differ greatly among members of a species. Early experience may lead individuals of the same species to differ somewhat in the details of a primarily instinctive behavior. For example, individual goldfinches show very similar basic behavior in building their nest. But the individuals may use different proportions of various materials to build their nests and may carry the materials in different ways.

How instinctive behavior works. Most instinctive behavior is *released* (brought about) by a *stimulus,* something that cues an animal to act as it does. For example, scientists have learned that a male stickleback begins to court a female when he sees her swollen abdomen. In laboratory experiments, male sticklebacks also court cardboard models, but only if the models have swollen abdomens. The female stickleback is attracted by the male's bright red belly. Females also follow crude models with red bellies more often than they follow exact copies of males without red bellies. The swollen abdomen of the female and bright red belly of the male are both examples of releasing stimuli.

A reflex, such as blinking at a bright light, is also a type of unlearned behavior released by a stimulus. But reflex actions are less complicated than instinctive behavior (see **Reflex action**).

In many cases, a releasing stimulus acts on one or more glands in an animal's body. For example, seasonal changes in the amount of daylight affect the glands of some kinds of birds. The glands secrete fluids called *hormones.* A change in the amount of hormones secreted stimulates the birds to migrate. If a gland does not secrete a certain hormone properly, an animal may not carry out the instinctive behavior associated with that hormone.

Some glands produce hormones only at a certain stage in an animal's life. The sex glands, for instance, do not function completely in young animals.

Instinct and learning. Most animals perform both instinctive actions and learned actions. Behaviors of insects, spiders, and *crustaceans* (such animals as crabs and lobsters) are largely instinctive. These animals do modify their behavior by experience, but they depend on built-in behavior patterns more than do higher animals, such as fish, amphibians, reptiles, birds, and mammals. Higher animals seem to use learning more as their behavior develops. Young chickens, for example, crouch motionless when any moving object appears above them, even if it is only a falling leaf. Older birds learn that leaves will not harm them, and so they do not react as they once did. But older birds do crouch motionless at the approach of a hawk.

Human beings seem to modify much of their behavior by learning. However, infants show much instinctive behavior, including smiling and sucking. Infants may use instinctive behavior when they have had limited time to learn behavior important for their survival.

One interesting type of behavior pattern is called *imprinting.* It occurs when an animal learns to recognize a stimulus that will later release instinctive behavior. For example, a gosling follows the first moving object it sees shortly after hatching. The young goose "recognizes" the moving object as its parent. It later "recognizes" similar objects as members of its own species. The gosling's behavior works out well if the first moving object is an adult female goose. But young geese hatched in an incubator may see humans first—and become *imprinted* toward them. That is, the goslings act toward humans as they should act toward other geese. After they mature, they even court humans. In many cases, animals that become imprinted toward animals of another species never learn to recognize members of their own species.

Survival and successful reproduction for most animals depend on a combination of instinct, learning, and body changes. For an animal to develop normal behavior, it must come in contact with the normal releasing stimuli for members of its species.

Scientists have raised monkeys separately from all other monkeys. Such monkeys do not display normal social or sexual behavior if, after reaching adulthood, they are placed with other monkeys. Normal adult monkey behavior results from experiences while growing up as a member of a group of monkeys. These experiences enable a monkey to perfect its instinctive behavior through learning. Larry L. Wolf

See also **Ethology; Dog** (Behavior); **Insect** (Why insects behave as they do); **Habit.**

Institute for Advanced Study, in Princeton, N.J., is an independent community of scholars and scientists engaged in advanced research and study. Individuals at the institute do not follow a set program of research, but determine their own lines of study. In addition, there are no examinations, and no degrees.

The institute is divided into four schools: historical studies, mathematics, natural sciences, and social science. It has a permanent faculty of less than 30 scholars and scientists. It also has 150 or more *visiting members,* who spend a year at the institute. About a third of these members come from countries other than the United States. All of them have doctor's degrees. Visiting members are chosen because of their ability in research and because of the relationship of their projects to work being done at the institute. They are given offices, subsidized housing, and the freedom to carry out their individual research projects.

The institute was founded in 1930. Through the years, the faculty of the Institute for Advanced Study has included such great scientists as Albert Einstein and J. Robert Oppenheimer.

Critically reviewed by the Institute for Advanced Study

Institute of France is a group of five learned societies that are encouraged and supported by the French government. Each society fosters a branch of learning. The institute gives yearly prizes for the best work in each field. Established by the French constitution of 1795, the institute was formed by four existing learned societies. A fifth group was permanently founded in 1832. The institute's headquarters are in Paris. Its five branch societies are:

The French Academy, founded in 1635, promotes and judges French literature. The 40 members of the academy are referred to as the *Forty Immortals* (see **French Academy**).

The Academy of Inscriptions and Belles Lettres, founded in 1663, studies ancient history and inscriptions, and ancient and Oriental languages.

The Academy of Sciences, founded in 1666, studies and promotes biological and physical sciences.

The Academy of Fine Arts, founded in 1648, promotes music and the fine arts.

The Academy of Ethical and Political Science, permanently founded in 1832, studies and promotes philosophy, law, and the social sciences.

Critically reviewed by the Institute of France

Institute of International Education. See **Fulbright Scholarship.**

Institute of Medicine. See National Academy of Sciences.

Institution. See Sociology (Social institutions).

Institution, Public. See Hospital; Library; Museum; School; Universities and colleges.

Instrument, Musical. See Music (Musical instruments).

Instrument landing system. See Airplane (Safety).

Insular Cases. See Territory (In the United States).

Insulation is the restriction of heat, sound, or electricity within a specific area. The term also refers to the materials used to control the flow of these forms of energy.

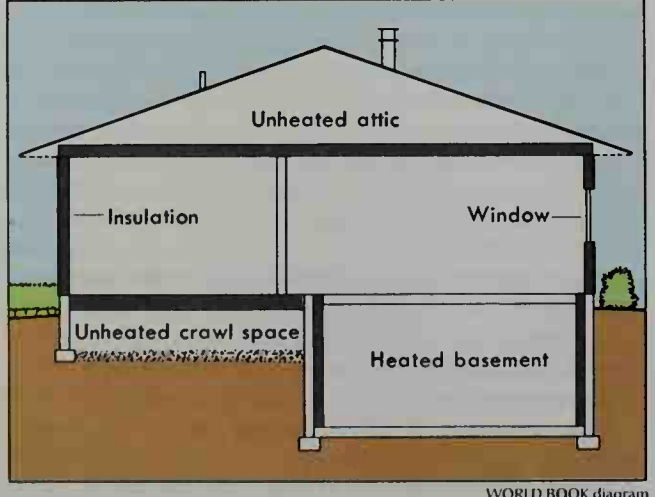
This article discusses the use of insulation to control heat flow and to limit the spread of sound. For information about insulation against electricity, see **Insulator, Electric.**

Insulation to control heat flow

Heat flows from a warm area to a cooler one by means of (1) conduction, (2) convection, and (3) radiation. Insulation reduces this natural movement (see **Heat** [How heat travels]). A vacuum bottle is a familiar example of such insulation. It keeps liquids hot or cold by limiting the flow of heat in or out of the bottle. A vacuum bottle is actually a bottle within a bottle separated by a vacuum. The two bottles may be made of glass or steel. There are few air molecules in the vacuum to carry heat, and so little heat can pass from the inside bottle to the outside bottle. The surfaces facing each other in a glass vacuum bottle also have a silver coating that restricts the flow of heat by reflecting it back to its source. Those in a steel vacuum bottle are separated by a layer of copper foil that serves the same purpose. See **Vacuum bottle.**

In homes and other buildings, insulation reduces the flow of heat outward during cold weather and inward during hot weather. In industry, insulation helps maintain certain temperatures necessary for processes used in manufacturing and other operations.

Materials used for insulation include fiberglass, metal foil, rock wool fibers (also called *mineral wool*), and certain plastics. These materials are poor conductors of heat. When placed against a heated or cooled surface, they provide a barrier to the flow of heat. In addition, most insulation materials are designed to have cell-like spaces that reduce the motion of hot or cold air.



WORLD BOOK diagram

Insulation for heat control reduces the heat flow through ceilings and walls to unheated or uncooled parts of a house or to the outside. The insulation should be installed in the areas where such heat flow could occur, as shown in gray in this diagram of a well-insulated house. Adequate insulation can greatly reduce the amount of fuel needed to heat a home.

In buildings, insulation is installed in the areas where the greatest heat loss or heat gain occurs. In most homes, these areas are the attic floor, the ceiling of an unheated basement, and the side walls. Insulation for the side walls is installed in the space between the interior and exterior walls. If a basement is heated, its side walls should be insulated.

Almost all insulation needs a *vapor barrier* to prevent moisture from penetrating the insulation and decreasing its effectiveness. A vapor barrier can be a sheet of foil, plastic, or treated paper. It must be put on the side of the insulation that faces the heated area.

The effectiveness of an insulation material is designated by its *R-value,* a measurement of the material's resistance to the flow of heat. Materials with high R-values have the greatest heat flow resistance. Buildings in cold climates require greater resistance to heat flow than do structures in warm areas. Insulation that is properly installed and has an adequate R-value can greatly reduce the amount of energy required to heat or cool a building.

Insulation should be fire-resistant and able to resist any physical or chemical changes that could reduce its effectiveness. It should also be resistant to destructive small animals, such as insects, mice, and rats.

There are five chief kinds of insulation for buildings: (1) batts and blankets, (2) loose-fill insulation, (3) cellular plastics, (4) rigid insulation boards, and (5) reflective insulation.

Batts and blankets are soft, flexible units made of fiberglass and rock wool fibers. Batts are cut to certain sizes by the manufacturer. Blankets are sold in long rolls that can be cut to any size during installation. Batts and blankets are used between the *joists,* the beams that support the floor and ceiling, and between *wall studs,* which make up the vertical part of the building frame.

Loose-fill insulation consists of short fibers of fiberglass, rock wool, or cellulose, or small particles of perlite or vermiculite. It can be blown or poured into attics. It is installed between the interior and exterior walls by blowing it through small holes in one of the walls.

Cellular plastics are used to make foam boards, which can be attached to a wall or roof. These plastics are also used to make insulating foam that can be injected into the finished walls of rooms and refrigerators.

Rigid insulation boards are made from such materials as fiberglass, gypsum, and perlite. They can be attached to the ceiling, roof, or walls.

Reflective insulation consists of thin sheets of aluminum foil. The sheets are arranged in layers, and the layers are separated by spaces that limit the movement of air. Reflective insulation is used between the joists and between wall studs.

In industry, insulation plays an important part in various operations. For example, some industrial furnaces are lined with blankets that resemble those used in home insulation. Industrial insulation blankets are made of ceramic fibers and can withstand temperatures as high as about 2400 °F (1300 °C). These blankets reduce

Some kinds of insulation for heat control

Owens-Corning Fiberglas Corporation

Batts and blankets are soft, flexible units made of fiberglass or of mineral wool fibers. They are stapled between the joists that support the ceilings and floors.

CertainTeed Corporation

Loose-fill insulation consists of small pieces of fiberglass or other insulating material. It can be blown into unfinished attics and walls, or through small holes into finished walls.

William W. Meyer & Sons, Inc.

Liquid insulating foam is one type of insulation made from cellular plastic. The foam is injected into finished walls through small holes. The liquid foam hardens as it dries.

Dow Chemical Company

Rigid insulating boards may be made from cellular plastics, fiberglass, gypsum, or perlite. In this picture, plastic insulating boards are being attached to finished roofs and walls.

the flow of heat from a furnace so that high temperatures can be maintained during the heating process.

Furnaces used in steelmaking are insulated with ceramic bricks that can endure temperatures up to about 3600 °F (2000 °C). The bricks prevent the hot molten metal inside the furnace from damaging the furnace's metal parts. Ceramic insulation must also be able to withstand sudden changes in temperature and many types of chemical reactions.

Insulation is also used to maintain certain temperatures in pipelines that transport hot or cold substances. For example, fiberglass insulates the Trans-Alaska Pipeline, which carries hot crude oil a distance of about 800 miles (1,300 kilometers). This insulation helps maintain the high temperatures needed to pump crude oil through the pipeline. It also prevents the heat of the oil from damaging the surrounding frozen land.

Insulation against sound

Insulation against sound is used in buildings to reduce noise. Some types of such insulation block sound and thus prevent it from passing from one room to another. Other kinds, which absorb sound, reduce the noise level within a room. See **Acoustics**.

Thick, heavy walls without cracks block such sounds as loud music and noisy conversation. But many modern buildings have thin, lightweight walls through which sound can easily pass. In such cases, sound-deadening boards made of wood fibers can be installed in the walls and ceilings. Such insulation must cover the entire surface because even a small gap allows much sound to pass through. Carpeting and other floor coverings help block the passage of sound to rooms below.

Noise in a room may be reduced by carpeting, draperies, and upholstered furniture, all of which absorb sound. For additional sound absorption, acoustical tiles may be installed on the ceilings and walls. These tiles have tiny holes that trap sound and prevent it from bouncing back into the room.

In industry, insulation against sound reduces noise in factories and in machines used at construction sites. Some factories have sound barriers between the workers and the machines. In others, sound-absorption materials are molded to the machines to lower their noise

level. Insulation is also used to reduce noise in such construction machines as air compressors and pneumatic drills. David L. McElroy

Insulator, *IHN suh LAY tuhr,* **Electric,** is a material that conducts almost no electricity. Insulators, also called *dielectrics,* are used to prevent electric current from flowing into places where it would be undesirable or dangerous. Such materials as dry wood, glass, mica, plastics, and rubber are insulators. Dry air and certain oils may also serve as insulators.

Rome Cable Corporation, New York

Metal power cables are covered with rubber and other insulating materials to prevent electric current from flowing into places where it would be undesirable or dangerous.

An insulator conducts electric current poorly because its electrons are bound so tightly to their nuclei that they cannot move freely from atom to atom. Therefore, when an insulator is connected to a battery or other source of electric energy, not enough electrons move through the insulator to produce a current. In contrast, materials called *conductors,* which include such metals as aluminum, copper, and silver, have electrons that are weakly bound to their nuclei. These electrons travel freely, resulting in a flow of electricity. Materials called *semiconductors* also have relatively low resistance to current flow. Semiconductors, such as germanium and silicon, conduct electricity better than insulators but not as well as conductors.

Insulators are used in many kinds of electrical and electronic equipment. For example, metal wires and cables that conduct electricity from power plants to homes and offices are covered with insulating materials to prevent the leakage of current. Insulators are also used in *capacitors* to increase their ability to store an electric charge (see **Capacitor**). When working around high-voltage equipment, electricians use tools with plastic or rubber handles and wear rubber-soled shoes to avoid injury from electric shock. Robert B. Prigo

See also **Electric current.**

Insulin is a hormone that regulates the body's use of sugar and other food. It is produced in specialized cells in the *islets of Langerhans,* a part of the pancreas. Certain insulin-related abnormalities cause the disease *diabetes mellitus,* often simply called diabetes. In this disease, the body cannot use sugars properly and *glucose* (a form of sugar) builds up in the blood (see **Diabetes**). Insulin also affects the body's use of protein, fat, and mineral products, such as potassium and phosphate.

How insulin acts in the body. When food is absorbed into the bloodstream, the pancreas increases the secretion of insulin into the blood. Insulin speeds the movement of nutrients from the bloodstream into *target cells* located mainly in liver, muscle, and fat tissues. Specialized protein molecules called *insulin receptors* lie on the surface of the target cells. The insulin receptors bind to insulin, which activates the receptors. The activated receptors on cells hasten the entry and utilization of the nutrients. Glucose and other simple sugars, produced by the digestion of more complex carbohydrates, are used for immediate energy or converted to glycogen for storage. Amino acids, produced by the digestion of proteins, move into cells and there form the building blocks for proteins. Fatty acids, produced by the digestion of fats, are converted to tryglycerides for storage and later used for energy.

Diabetes. An insufficient amount of insulin in the body causes a form of diabetes called *Type I diabetes.* In a milder form of diabetes known as *Type II diabetes,* the patient usually produces normal amounts of insulin. But the body does not utilize insulin properly. This may occur because the patient has too few insulin receptors or has defective receptors. In most patients, the cause of the disorder is not known. In some, tumors in the islets of Langerhans produce excessive insulin, causing the blood sugar to fall to a level far below normal, a condition called *hypoglycemia.* See **Hypoglycemia.**

In treating diabetes, insulin is usually injected under the skin. If insulin is taken by mouth, digestive fluids destroy the hormone. Treatment with insulin does not cure diabetes, but it does control the disease and allow the patient to live an almost normal life. Until the early 1980's, insulin for diabetics was obtained chiefly from the pancreases of cattle and hogs. Today, insulin is also produced by genetically engineered bacteria (see **Genetic engineering** [Uses of genetic engineering]).

Pure insulin is rapidly absorbed by the body and its effect lasts only a short time. Drug companies manufacture various insulin preparations that prolong the hormone's effect. Such preparations are made by combining insulin with proteins or by modifying the hormone's chemical structure. To best mimic the body's normal pattern of insulin secretion, diabetic patients may use different types of insulins and administer them one to five times daily. Some diabetics have insulin pumps implanted under the skin. The pumps are programmed to release insulin at specific times.

History. The existence of a sugar-regulating substance in the pancreas was shown by surgical experiments on dogs in 1889 in Germany by two physicians, Oscar Minkowski and Joseph von Mering. Researchers at the University of Toronto, particularly Frederick G. Banting, Charles H. Best, John J. R. Macleod, and James B. Collip, isolated and prepared insulin. They used it for the first time in diabetic patients in 1922. The first genetically engineered human insulin was produced by American scientists in 1978. Jesse Roth

See also **Banting, Sir Frederick G.; Best, Charles H.; Hormone; Pancreas.**

Insurance is a means of providing protection against financial loss in a great variety of situations. For example, life insurance helps replace income lost to a family if a wage-earning parent dies. Health insurance helps pay medical bills. Fire insurance pays all or part of the loss if a homeowner's house is destroyed by fire. Automobile insurance helps cover the costs of damages resulting from a car accident. People also can buy insurance to cover unusual types of financial losses. For example, athletes can insure their bodies against injury.

Insurance works on the principle of sharing losses. People who wish to be insured against particular types of losses agree to make regular payments, called *premiums,* to an insurance company. In return, these people receive a contract, called a *policy,* from the company. The company promises to pay them a certain sum of money for the types of losses stated in the policy. The individuals paying premiums are called *policyholders.* The amount of money paid by the insurance company to the policyholders is known as the *benefit* or the *claim.* The insurance company uses the premiums to buy stocks, bonds, mortgages, government securities, and other income-producing investments. The company pays benefits from the premiums it collects and from the investment income the premiums earn. Insurance works because policyholders are willing to trade a small, certain loss—the premiums—for the guarantee that they will be *indemnified* (paid) in case of a larger loss.

Although a policyholder may never receive benefits from an insurance company, the premiums have not been wasted. Insurance gives policyholders a feeling of security. Policyholders know they will be indemnified if a loss should occur. They can therefore own property, drive a car, operate a business, and engage in many other activities without worrying about the financial losses that might result.

Insurance works well only when the possible losses to the insured person can be estimated. Insurance companies take advantage of the *laws of probability.* These laws enable an insurance mathematician called an *actuary* to determine the likelihood that an event will occur. Laws of probability are based on the *law of large numbers.* As the number of auto insurance policyholders increases, for example, an insurance company can use this law to predict with ever-greater accuracy the number of policyholders who will be in an accident.

Insurance generally covers only situations involving *pure risk*—that is, situations in which only losses can occur. Such situations include fire, flood, and accidents. Insurance does not cover gambling and other *speculative risks,* in which either losses or gains may result.

This article discusses the three main types of insurance sold by insurance companies. These types are (1) life insurance; (2) private health insurance; and (3) property and liability insurance.

Life insurance

A life insurance policy provides that the insurance company will pay a certain amount of money when the person insured dies. The amount of money is called the *face value* or *death benefit* of the policy. It is paid in a lump sum or in installments to the *beneficiary,* the person or persons named by the policyholder to receive the death benefit. Most policyholders insure themselves or members of their family. But a person may insure the life of a nonrelative if the nonrelative permits it.

Wage earners buy life insurance chiefly to replace income that would be lost to their families if they died. Money from an insurance policy can help support a wage earner's children until they are old enough to support themselves, and it can provide funds for their education. It can also help provide an income for a surviving spouse. Money from the death benefit can be used to pay the deceased's mortgage, medical bills, funeral expenses, and other debts. It may also be used to pay estate and inheritance taxes. Businesses often buy life insurance to cover key employees and to provide money to continue the business if a partner dies. Many life insurance policies have a *living benefits* provision, which allows policyholders who are terminally ill or confined to a nursing home to receive benefits before they die.

Some types of life insurance policies also enable policyholders to save money. Such policies have a *cash value.* A policyholder may borrow money against the cash value or *surrender* (turn in) the policy for its cash value. Any amount borrowed against the cash value, plus interest, is subtracted from the face value if the insured person dies before the loan is repaid. Some policies have a *double indemnity* clause. It provides a payment of two to three times the face value of the policy if the insured person dies as the result of an accident.

Main kinds of life insurance. There are three main kinds of life insurance: (1) term life insurance, (2) whole life insurance, and (3) universal and variable life insurance.

Term life insurance provides benefits only if the insured person dies within the period covered by the policy. This period may range from 1 to 40 or more years.

Term life insurance costs less than other types of life insurance for the same amount of coverage because it has no cash value. Many insurance experts recommend term insurance for people on a limited budget or who require coverage for only a short time. Many people with young children buy term insurance to cover the period until the children are grown.

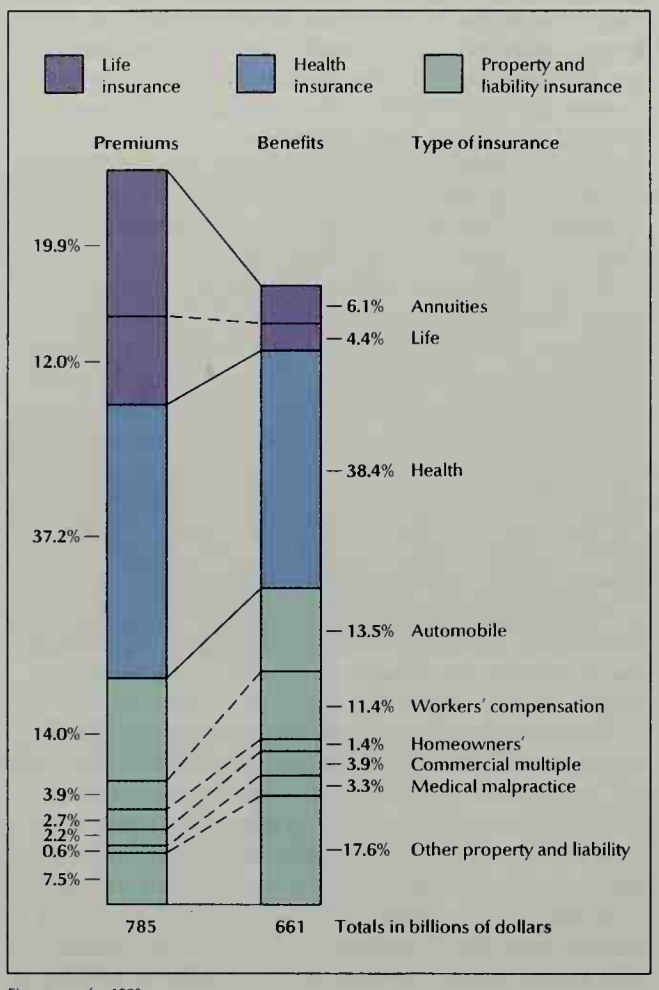
A type of term insurance called *renewable term life insurance* enables a policyholder to continue the policy automatically for another term when the policy expires. Such policies permit the policyholder to renew several times. But the majority of insurance companies do not permit renewal after the insured person reaches the age of 65 or 70. The premiums rise each time the policy is renewed because the probability of death increases with age. The premiums rise dramatically for older people.

People who feel that in the future they may prefer a policy with a cash value can buy *convertible term insurance.* A person with such insurance can convert the term policy to a whole life policy when the term policy expires. Another variation of term insurance is *decreasing term insurance.* The face value of the policy decreases during the period of the policy. A common type of decreasing term insurance used for paying off loans if the borrower dies is called *credit life insurance.* The amount of coverage that is provided by a credit life policy decreases as the loan is repaid. The insurance provides funds to cover the unpaid balance of a loan or mortgage if the borrower dies.

Many businesses provide life insurance to their em-

Major types of insurance in the United States

This graph shows the percentage of money that insurance companies collect in premiums and pay out in benefits on the major types of insurance. Overall, they pay out about 85 cents in benefits for every dollar received in premiums. They also use premiums to pay expenses and dividends, make investments, and keep a reserve against future claims. The balance is profit.



Figures are for 1993.
Sources: American Council of Life Insurance; Health Insurance Association of America; A. M Best Company.

ployees through a *group life insurance plan.* Most such plans offer term insurance. In nearly all cases, the premiums for group life policies cost less than the premiums for individual policies, partly because group plans have lower administrative costs. In addition, employers often pay at least part of the premiums. Some labor unions, professional associations, and other organizations also provide group life insurance to their members.

Whole life insurance provides coverage for the lifetime of the person insured. The most common whole life policy is a *straight life policy,* also called a *continuous premium policy.* The premiums are payable as long as the insured person lives. A *limited payment policy* also gives lifetime protection. However, it provides for completing the payments within a limited period, usually 20 or 30 years, or at a certain age, such as 65. The premiums are higher than for straight life because they are paid for fewer years.

Unlike most term life insurance premiums, whole life premiums do not increase with the age of the person insured. Whole life insurance costs more than term insurance, however. Policyholders of whole life insurance actually pay more than the amount needed to cover the statistical risk of death at their age. This excess amount, plus the interest paid on it by the insurance company, accumulates and forms the policy's cash value. The cash value increases with the age of the policy. When the insured person dies, however, the beneficiary receives only the face value, regardless of the cash value.

Many whole life policyholders borrow against the cash value or surrender their policies for the cash value to supplement their retirement income or to meet major expenses. A policyholder who surrenders a whole life policy can take advantage of *nonforfeiture options* in the policy to buy another policy. The policyholder can use all or part of the cash value to purchase *extended term insurance* or *paid-up insurance.* Extended term provides coverage equal to the face value of the original policy but for a limited period. Paid-up insurance provides lifetime coverage but at a lower face value.

Universal and variable life insurance. In the 1970's, the life insurance industry developed some new kinds of life insurance. These new kinds include *universal life insurance* and *variable life insurance.*

Universal life insurance may offer better investment returns than traditional life insurance policies. Interest rates on a universal policy's cash value are competitive with money market funds and money market accounts. Universal life insurance also allows policyholders to adjust their coverage to meet changing economic or personal conditions. For example, policyholders can change the proportion of term life insurance and whole life insurance in a policy. They can also increase or decrease the face value of the policy, raise or lower the premiums they pay, and shorten or lengthen the premium-paying period.

Variable life insurance policies are supported by investments, usually in the stock market. The face value and cash value of variable life insurance policies vary according to the performance of the investments. Usually a minimum face value or death benefit is guaranteed regardless of how the stocks perform. Many companies offer *universal variable life insurance,* which combines features of universal life insurance and variable life insurance.

Dividends. Some insurance policies refund part of the premiums to policyholders in the form of dividends. Such policies are called *participating policies.* An insurance company pays dividends if the money it collects in premiums exceeds the amount needed to pay benefits and administrative costs. Dividends also may include a share of the profits the company earns on investments made with premium funds. Dividends may be paid on many types of insurance. But they are most commonly paid on life insurance. Policies that do not pay dividends are known as *nonparticipating policies.*

An owner of a participating policy may receive the dividends in cash or allow them to accumulate with the insurance company, which pays interest on the amount. A policyholder may also use the dividends to help pay the premiums on the policy or to purchase additional insurance.

How premiums are figured. Life insurance premiums are based chiefly on statistical tables called *mortality tables.* These tables state the probability of dying at a

given age during a period of one year. Insurance companies also base premiums on the interest they expect to earn from investments made with the premiums and on the cost of doing business.

The amount of the premiums may also be affected by a person's *insurability*—that is, the risk the insurance company takes in providing coverage for that person. A person who has high blood pressure, diabetes, or some other medical condition may be charged higher premiums. An individual whose work or leisure activities are considered dangerous may also pay higher premiums. The majority of insurance companies charge substantially higher premiums to smokers, and many companies charge lower rates to nondrinkers and people who exercise regularly.

Buying life insurance. Many insurance experts believe wage earners should buy life insurance only if they have dependents. They recommend that a family with two or more children have life insurance equal to about four or five times the family's annual income.

Authorities disagree on which type of life insurance a person should buy. Some experts recommend whole life insurance because the premiums remain fixed for the lifetime of the insured. They point out that whole life insurance results in forced savings and so may be attractive to people who find it difficult to save. The cash value of the policy can be borrowed against, or the policy can be surrendered for its cash value.

Other experts prefer term life insurance because it provides the same amount of protection as whole life insurance but does so at a lower cost. They also criticize the low interest rates paid by many companies on the cash value of traditional whole life policies. These experts point out that a policyholder can earn more interest in other ways.

Insurance experts recommend that a person who wishes to purchase life insurance consult a guide called the *surrender cost index.* This guide enables a potential buyer to compare the costs of some similar policies offered by different companies. Many states require insurance companies to furnish the surrender cost index to potential buyers.

Annuities are savings plans sold chiefly by insurance companies to provide retirement income. They provide fixed, regular payments to the *annuitant* (owner of the annuity). A type of annuity called a *life annuity* ceases on the death of the annuitant. A *life annuity with installments certain* provides payments during the lifetime of the annuitant or for a fixed number of years, whichever is longer. If the annuitant dies before receiving the guaranteed number of payments, the insurance company must continue the payments to the beneficiary.

Some types of annuities guarantee the refund of all money contributed by the annuitant. If the annuitant dies before receiving the full amount contributed, the beneficiary receives the balance.

A *joint and survivorship annuity* provides income to two people. Payments are made initially to both people. When one dies, the survivor usually receives smaller payments until his or her death. *Variable annuities* can protect annuitants against inflation. Variable annuity funds are invested principally in stocks, and the payments vary according to the performance of the stocks. Ideally, as inflation increases, stock prices will also increase and provide higher payments to annuitants.

Employees of nonprofit organizations and public school systems can buy *tax-deferred annuities.* People who purchase this type of annuity can postpone paying taxes on the income they contribute to the annuity until a later date, usually after retirement.

Private health insurance

Health insurance pays all or part of the cost of hospitalization, surgery, laboratory tests, medicines, and other medical care. The high cost of medical care makes it important for people to have adequate health insurance. People without such coverage could suffer a major financial hardship in case of a serious illness or accident.

A large majority of people in the United States have some form of private or public health insurance, though many have limited coverage. Many millions of Americans are uninsured.

In numerous countries, the government provides health care for the nation's people. These countries include Australia, Canada, Ireland, New Zealand, and the United Kingdom. In Canada, nearly all people are covered by provincial government health insurance. In the United Kingdom, the National Health Service provides government-funded medical services to all residents. In Canada, the United Kingdom, and other countries with government health care programs, private insurance companies offer additional coverage to people who wish to purchase it. For information on public health insurance, see the section *Social insurance* in this article.

Private health insurers sell individual and group policies. However, most people with private health insurance are covered under a group plan where they work. Group plans typically cover not only the insured person but also that person's dependents. Group health insurance generally costs less than individual coverage because administrative costs and other expenses are lower. Many employers pay all or part of the premiums for their employees.

How private health insurance is provided. Private health insurance in the United States is offered mainly by (1) insurance companies, (2) medical service plans, (3) managed care plans, and (4) self-insured employers.

Insurance companies. Many companies that sell health insurance policies provide *cash benefits,* also called *indemnity benefits,* to the insured person. A cash benefit is a fixed dollar amount for each medical expense or day of hospitalization. If the cash benefits do not cover the entire cost of medical care, the policyholder must pay the balance.

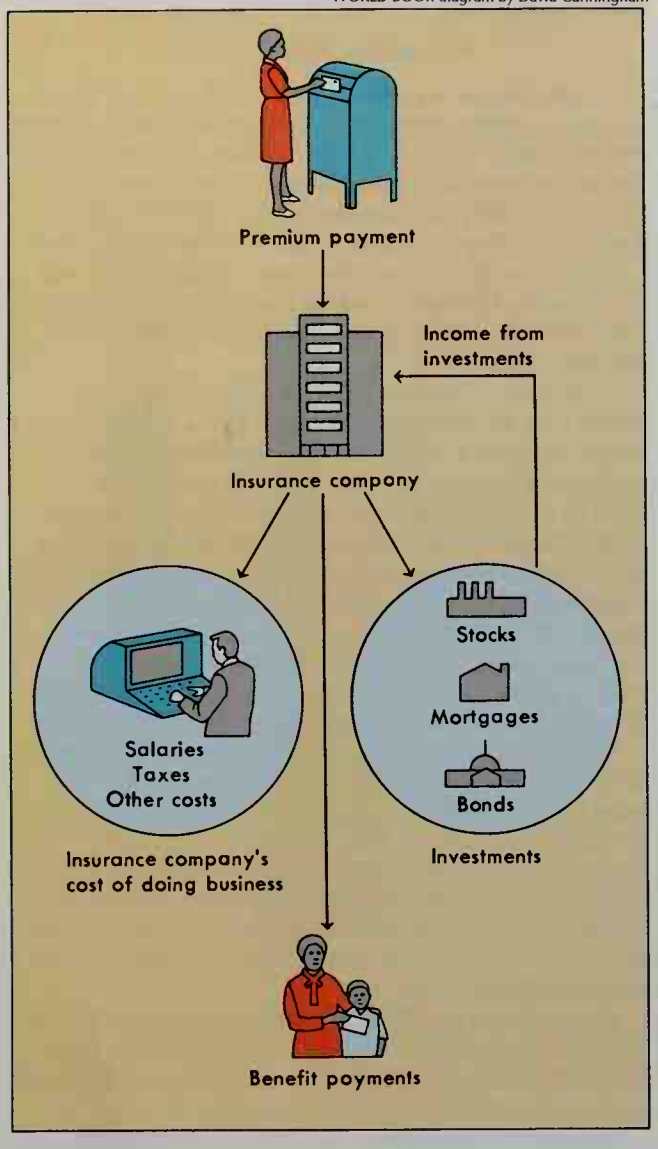
Medical service plans pay *service benefits.* A service benefit is a direct payment to the hospital or physician that provided the medical service. Payments are limited to *reasonable and customary charges.* Such a charge is the average cost of a particular medical service in the area in which the insured person lives. In most cases, health insurance policies with service benefits offer fuller coverage but cost more than policies with cash benefits. Unlike insurance companies, medical service plans operate on a nonprofit basis. Blue Cross and Blue Shield plans are the largest medical service plans in the United States (see **Blue Cross and Blue Shield**).

Managed care plans have grown tremendously since the 1980's. They help limit the cost of health care by

What happens to an insurance premium

An insurance company buys stocks and bonds and makes other investments with the premiums it collects. It uses the premiums and the income from its investments to pay its operating costs, make benefit payments, and provide a profit for its owners.

WORLD BOOK diagram by David Cunningham



managing the provision and financing of care. The most widely used types of managed care plans are health maintenance organizations (HMO's) and preferred provider organizations (PPO's). In the United States, a large majority of workers in group plans sponsored by their employers are covered by managed care plans.

HMO's provide nearly complete health care services for a prepaid monthly or yearly fee. Such services range from hospitalization and surgery to medication and visits to a physician's office. HMO's are sponsored by various foundations, communities, medical groups, insurance companies, and medical service plans.

PPO's give employers discounts if they send their employees to health care providers that belong to the PPO. Employees tend to use the PPO's health care providers because they must pay more for their health care if they receive it from someone else. Like HMO's, PPO's provide nearly complete health care for a monthly or yearly fee. In both PPO's and HMO's, patients may be required to pay a small additional fee, called a *copayment,* for the medical services and medications they receive.

Self-insured employers pay the health care costs of their employees instead of buying insurance. In this way, companies can design benefit plans to suit their circumstances, and they may profit by investing the money that would be spent on insurance.

Basic types of health insurance. Private health insurers offer four main types of health insurance benefits. They are (1) hospital expense, (2) physician expense, (3) outpatient expense, and (4) major medical expense benefits. Most experts recommend that a person select a policy that offers all four types of benefits.

Hospital expense benefits are the most common type of medical insurance benefits. They cover the cost of hospital room and board, laboratory tests, X rays, medication, nursing services, and the use of an operating room. The benefits may take the form of cash or services. Some policies limit cash benefits to fixed daily payments for a stated number of days each year.

Physician expense benefits cover such services as a surgeon's operating fees. Many policies pay the total cost of such fees to a reasonable and customary limit. But under some policies, if the surgeon charges a higher fee, the insured person must pay the additional cost.

Outpatient expense benefits cover fees charged by physicians for nonsurgical care in their office, in a hospital, or in the patient's home. These benefits also cover the cost of X rays and laboratory and diagnostic tests for a policyholder who is not hospitalized.

Major medical expense benefits cover the enormous costs resulting from a serious illness or accident. Maximum benefits typically range from $100,000 to $1,000,000, though some policies have no limit. However, many policies that are not part of a managed care plan pay only 90 percent of the expenses covered by the policy. In addition, almost all major medical policies that are not part of a managed care plan have a *deductible*—that is, an initial sum of money for which the policyholder is liable. The insurer pays any excess costs up to the amount specified by the policy.

Other types of health insurance include *disability income insurance, dental insurance,* and *long-term care insurance.* Disability income insurance provides funds that partly replace income lost when the insured person cannot work because of an accident or illness. Dental insurance helps pay for a wide variety of services. Cleaning and X rays are often fully covered. Most policies provide limited coverage for other dental services by paying a maximum dollar amount or percentage of the cost. Long-term care (LTC) insurance provides coverage for nursing home care and related expenses.

Some employers offer plans called *medical savings accounts* (MSA's), which allow people to set aside money for medical costs that are not covered by insurance. The money is deducted from workers' paychecks and is not taxed. Similar plans known as *flexible spending accounts* (FSA's) allow people to spend the funds on children's day care and summer camp expenses, in addition to normal medical costs.

Property and liability insurance

Many individuals and businesses buy property and liability insurance to protect their assets against financial

loss. Property insurance provides direct compensation if a policyholder's possessions are damaged, destroyed, or lost as a result of *perils* specified in the policy. A peril may be natural or the consequence of human actions. Commonly insured natural perils include fires, tornadoes, and hail. Perils caused by the actions of people include automobile accidents, burglary, and arson. Policies may be written on an *all-risks* basis. But some perils, such as war and nuclear contamination, are not covered under such policies.

Property insurance policies limit the amount of compensation for losses. Nearly all policies have a deductible for which the policyholder is liable. The sum the policyholder can recover also is limited by the face value of the policy. Most policies pay losses on the basis of what it would cost to replace the property. Other policies restrict compensation to the actual cash value of the property—that is, the replacement cost of the property minus depreciation.

Liability insurance protects individuals and businesses against possible financial losses if their actions result in bodily injury to others or in harm to property owned by others. A victim of such actions could sue the person or business responsible. If the court judges the defendant to have been negligent, it may order the defendant to pay damages to the victim. Liability insurance pays for these damages and a policyholder's defense costs. Most liability cases are settled out of court. In such cases, the policyholder's insurance company and the person claiming injury agree on the amount of the damages. Liability insurance thus indirectly protects a policyholder's assets, which would otherwise be used to pay the damages. Most insurance experts recommend that policyholders carry high liability limits.

Insurance companies sell several types of property and liability insurance. The main types of individual coverage are (1) homeowners' insurance and (2) automobile insurance. Most people can obtain sufficient property and liability coverage by buying both types.

Homeowners' insurance provides protection against losses from damage to an owner's home and its contents. People who rent may buy a type of homeowners' insurance called *tenants' insurance* or *renters' insurance,* which covers only the policyholder's personal property. Homeowners' and tenants' policies are *package policies,* which means they provide both property and liability coverage for a variety of perils. Package policies also are called *multiple-peril insurance.*

Homeowners' property insurance protects against losses from such perils as fire, tornadoes, vandalism, theft, explosion, riot or civil disturbance, and damage by automobiles, aircraft, and other vehicles. Homeowners' policies do not cover damage caused by earthquakes and floods, though such coverage may be purchased separately. Perils for which property insurance cannot be obtained include war and nuclear radiation.

Homeowners' policies limit the amount of coverage on such items as cash, securities, coin collections, jewelry, silverware, guns, and furs. Property owners who wish to fully insure such valuables may buy additional coverage as part of their homeowners' policies.

An insurance company typically requires a policyholder to provide proof of the ownership and the value of lost or damaged property before it pays compensation. Thus, policyholders should have evidence of their possessions, such as lists, sales receipts, appraisals, or photographs. The evidence should be kept in a safe-deposit box or other secure place outside the home.

Homeowners' liability insurance protects a policyholder if a visitor is accidentally injured while on or while using the policyholder's property. The insurance company may pay damages even if the person claiming injury does not sue the policyholder. If the policyholder is sued and found not responsible, the insurance company still pays all of the policyholder's legal expenses.

Automobile insurance is the most widely purchased property and liability insurance. It is one of the most important kinds of insurance because of the serious injuries and extensive property damage that can result from auto accidents. Drivers are legally responsible for any costs arising from accidents they cause. Automobile insurance protects a policyholder against financial losses from accidents. It also provides compensation if a policyholder's car is stolen, vandalized, or damaged in a collision or by storms or other natural perils.

Like homeowners' insurance, most auto insurance policies are package policies and so offer both property and liability coverage. Although benefits vary according to the type of policy, nearly all policies provide four kinds of coverage. They are (1) liability coverage, (2) collision and comprehensive coverage, (3) uninsured motorists coverage, and (4) medical payments coverage. In addition, some U.S. states and Canadian provinces have passed laws providing for a type of accident insurance called *no-fault insurance.*

Liability coverage protects policyholders if an auto accident for which they are responsible causes bodily injury to others or damage to property. Liability coverage is considered essential for all car owners. In fact, over 40 U.S. states and all the Canadian provinces require motorists to have such insurance before they may own or drive a car.

Collision and comprehensive coverage pays for losses resulting from damage to a policyholder's auto. Collision insurance provides protection if the car hits another car or object or runs off the road. Comprehensive insurance covers losses from such perils as fire, theft, flood, and hail. Nearly all collision and comprehensive insurance has a deductible. The company thus does not compensate a policyholder for small losses.

Uninsured motorists coverage pays benefits to a policyholder injured by a driver who is judged to be responsible and who does not carry liability insurance. It also covers policyholders and their families who are injured by an uninsured driver while riding in another person's car or while walking. Injuries caused by a hit-and-run driver are also covered.

Medical payments coverage provides a small sum for the medical expenses of policyholders and their passengers injured in an auto accident. It pays benefits even if the policyholder is not at fault.

No-fault insurance enables auto accident victims to collect damages automatically from their own insurance company, regardless of who caused an accident. These damages chiefly cover medical expenses and loss of income. See No-fault insurance.

Other kinds of property and liability insurance include (1) special multiple-peril and business owners' in-

surance, (2) marine insurance, (3) crime insurance, (4) surety bonds, and (5) product and professional liability insurance.

Special multiple-peril and business owners' insurance provides property and liability coverage of business risks. It is similar to homeowners' insurance.

Marine insurance consists of two types of insurance that deal with risks involved in transportation. *Ocean marine insurance* covers commercial and recreational vessels operating on oceans, lakes, and rivers and in harbors. It includes both property and liability coverage and compensates for the loss of a vessel and its cargo. *Inland marine insurance* provides protection against losses connected with land transportation. It covers cargo as well as bridges, railroads, tunnels, and other facilities involved in transporting cargo.

Crime insurance protects policyholders against losses from such acts as theft, burglary, robbery, forgery, and embezzlement. Most homeowners' policies and commercial multiple-peril policies include theft, robbery, and burglary insurance.

Businesses may buy a type of crime insurance called *fidelity bonds*. Such insurance protects them against losses due to dishonest acts by employees who handle money or valuable merchandise.

Banks and other financial institutions purchase a broader type of crime insurance called *blanket bonds*. The bonds provide protection against criminal acts to bank property by nonemployees and employees as well as against fires, tornadoes, and other natural hazards.

Surety bonds guarantee that the insured will fulfill a certain obligation. One of the most important types of surety bonds is a *contract performance bond*. Under such a bond, the insurance company, sometimes called a *surety,* promises to see that a project is completed if the insured contractor fails to complete it according to the terms of the contract. Other types of surety bonds include *bail bonds* and *fiduciary bonds*. A bail bond guarantees the appearance in court of a person accused of a crime. If the accused person appears in court, the money for the bond is refunded. Otherwise, the money is forfeited. Fiduciary bonds guarantee the performance of people who are appointed by a court to be responsible for another's property.

Product and professional liability insurance protect manufacturers and professionals against losses from certain kinds of lawsuits. Product liability insurance protects manufacturers from suits in which consumers claim injuries as a result of using defective products. Professional liability insurance protects such professionals as physicians, accountants, and lawyers against losses from lawsuits in which a patient or client accuses them of error or negligence. Professional liability insurance is sometimes called *malpractice insurance*.

Government insurance programs

Social insurance is insurance administered or supervised by the government. It provides benefits to the elderly and to unemployed, disabled, and sick workers and their families, and to families of deceased workers. Social insurance programs are financed mainly by taxes paid by workers and employers. Participation in such programs is required for most workers. Benefits are paid to all people entitled to receive them, regardless of their need. Social insurance programs differ from public assistance programs, which are financed by general taxes and pay benefits according to an individual's need.

The major forms of social insurance in the United States are (1) old-age, survivors, and disability insurance, (2) Medicare, (3) workers' compensation, and (4) unemployment insurance. Most other industrialized nations and many less developed countries also have social insurance. For information on social insurance in Canada, see **Social security** (Social security in Canada).

Old-age, survivors, and disability insurance pays benefits to retired workers and their dependents, to disabled workers and their dependents, and to the survivors of workers who die. Nearly all American workers are covered by the insurance. Benefits are based on a worker's average earnings and are financed by a payroll tax shared by workers and employers. See **Social security** (OASDHI).

Medicare is a health insurance program. It covers nearly all Americans 65 years of age or older and certain disabled people. Medicare consists of *hospital insurance* and *supplementary medical insurance*. Hospital insurance is financed by a payroll tax paid by workers and their employers. The insurance helps cover the cost of hospital, nursing home, and at-home care. Supplementary medical insurance is financed by premiums paid by people eligible to receive benefits and by general tax revenues. It helps pay doctor bills and other medical costs not covered by hospital insurance. See **Medicare**.

Many elderly people supplement their Medicare coverage with private insurance called *Medigap* insurance. Medigap insurance pays hospital bills, doctor bills, and other medical expenses that Medicare does not cover.

Workers' compensation pays the cost of medical care for employees who are injured in a job-related accident or who contract a disease as a result of their job. Workers also receive compensation for lost income. In addition, the insurance provides payments to dependents of workers if death occurs. Employers pay the cost of the insurance. See **Workers' compensation**.

Unemployment insurance provides cash payments for a limited number of weeks to workers who lose their job. It is financed by a payroll tax paid by employers. See **Unemployment insurance**.

Other government insurance programs. Certain agencies of the U.S. government provide special types of insurance. For example, the Federal Deposit Insurance Corporation insures bank deposits. If an insured bank cannot pay its depositors, the corporation pays them, up to a maximum of $100,000 for each bank account. Farmers can obtain coverage against crop losses from flood, drought, and other natural perils through the government's Farm Service Agency. The Federal Insurance Administration provides protection against losses from flood damage in areas where floods often occur. The government also provides life insurance to members of the armed forces.

The insurance industry

Insurance companies play a vital role in the economy of many nations. They contribute to a country's economic stability by compensating individuals and businesses for financial losses that might otherwise ruin them. Insurance companies invest billions of dollars in stocks,

bonds, mortgages, government securities, and other income-producing enterprises. Insurance companies also help guarantee repayment of loans and the completion of commercial projects and public works. People can reduce the risks of starting a new business or acquiring property by buying insurance. Thus, the insurance industry helps increase the production of goods and services.

The United States and Japan have the world's largest private insurance industries. Nearly all other highly industrialized nations also have a well-developed private insurance industry. Most less developed countries have few private insurance firms.

Types of insurance companies. Most insurance companies in the United States and Canada are *stock insurance companies* or *mutual insurance companies.* A stock insurance company is owned by stockholders, who share in profits earned by the company. A mutual insurance company is owned by policyholders. Profits earned by a mutual company are returned to the policyholders as dividends or used to lower future premiums.

Other types of insurance organizations include *cooperative insurance companies* and *unincorporated proprietary insurers.* Cooperative insurance companies, also called *mutual benefit associations,* are fraternal, industrial, or union groups owned by and operated for the members of the group. Unincorporated proprietary insurers are associations of individuals who join to insure a particular risk. Lloyd's of London is the most important organization of this type (see Lloyd's).

How insurance is sold. Most insurance companies in the United States and Canada sell policies through agents and brokers. *Exclusive agents* are employees of an insurance company who sell only that company's policies. *Independent agents* are independent business owners who sell policies for several companies. Large businesses or other commercial organizations with extensive insurance needs frequently buy insurance through a *broker.* Brokers represent policyholders rather than insurance firms.

Government regulation. The insurance industry is heavily regulated in the United States and Canada. In the United States, the state governments have nearly complete control of insurance regulation. In Canada, both the federal government and the provincial governments regulate the industry.

Insurance companies are regulated mainly because policyholders pay in advance for benefits. Government regulations help ensure that the companies remain financially sound and so can meet their obligations. Government agencies periodically examine each company's methods, review its investments, and see that it has adequate funds in reserve to pay future claims. The government enforces laws concerning trade and marketing practices of insurance companies. Such laws are designed to prevent the sale of policies with unfair or misleading terms and to help guarantee that people who need insurance can obtain it.

In the United States, each state has a department that regulates and licenses insurance companies operating within the state. In Canada, the federal government deals chiefly with matters involving the financial stability of insurance companies. Provincial governments supervise the business and marketing practices.

Careers in the industry. The most familiar insurance employees are insurance agents and brokers. They serve as go-betweens for insurance companies and insurance buyers and policyholders.

The insurance industry offers other types of careers as well as those mentioned above. Specialty careers include those of *actuaries, underwriters,* and *claims adjusters.* Actuaries are mathematicians who use complex statistical tables to calculate premium rates for different risk situations and set insurance company reserves. Underwriters decide whether a company will accept a risk and, if so, at what price. Claims adjusters determine the extent of a company's liability and the amount that it should pay when policyholders suffer a loss. In addition, insurance companies employ accountants, computer specialists, finance experts, lawyers, librarians, engineers, and advertising and public relations specialists. Nearly all these workers have a college degree. Many have a graduate or specialized degree. An experienced agent or underwriter may become a Chartered Life Un-

15 largest United States life and health insurance companies

Company	Premiums	Assets	Year founded	Headquarters
1. Metropolitan Life Insurance Company	$24,643,000,000	$183,917,000,000	1868	New York City
2. Principal Mutual Life Insurance Company	15,710,000,000	76,018,000,000	1879	Des Moines, Iowa
3. Nationwide Life Insurance Company	14,316,000,000	86,556,000,000	1929	Columbus, Ohio
4. Cigna Corp	13,624,000,000	69,727,000,000	1792	Philadelphia
5. The Prudential Insurance Company of America	13,433,000,000	191,536,000,000	1873	Newark, N.J.
6. The Equitable Life Assurance Society of the U.S.	11,047,000,000	94,888,000,000	1859	New York City
7. John Hancock Mutual Life Insurance Company	9,623,000,000	60,732,000,000	1862	Boston
8. New York Life Insurance Company	9,558,000,000	68,812,000,000	1841	New York City
9. Health Care Service Corporation	8,864,000,000	2,650,000,000	1975	Chicago
10. Pacific Life Insurance Company	8,636,000,000	48,234,000,000	1868	Newport Beach, Calif.
11. The Northwestern Mutual Life Insurance Company	8,343,000,000	85,973,000,000	1857	Milwaukee
12. Blue Cross and Blue Shield of Michigan	8,243,000,000	3,473,000,000	1939	Detroit
13. Allstate Life Insurance Company	8,095,000,000	32,914,000,000	1931	Northbrook, Ill.
14. Jackson National Life Insurance Company	8,073,000,000	39,356,000,000	1961	Lansing, Mich.
15. Aetna Life and Casualty Insurance Company	7,839,000,000	50,825,000,000	1853	Hartford, Conn.

Figures are for 2000. Source: A.M. Best Company

derwriter (C.L.U.) or a Chartered Property and Casualty Underwriter (C.P.C.U.). To become a C.L.U. or a C.P.C.U., a person must pass tests in the field of life insurance or property and casualty insurance. Other insurance workers include secretaries, receptionists, and clerks.

History

Earliest insurance. Insurance is thousands of years old. The Code of Hammurabi, a collection of Babylonian laws of the 1700's B.C., included a form of credit insurance. A borrower did not have to repay a loan if personal misfortune made it impossible to do so. The borrower paid an extra amount for this protection in addition to the interest. Ancient Greek and Roman organizations provided their members with old-age pensions and disability insurance and with money for the members' burial. During the Middle Ages, *guilds* (associations) formed by craftworkers offered the same types of insurance as well as fire and theft insurance to their members.

The growth of insurance. Modern marine insurance and the practice of *underwriting* began about 1690 in a London coffee house owned by Edward Lloyd. Lloyd's was a popular meeting place for shipowners and merchants. A statement of a ship's cargo was recorded on a piece of paper and read by the coffee house patrons. Those willing to share the risk of insuring the cargo signed under the statement and indicated the share of the risk they would *underwrite* (guarantee).

Earlier in the 1600's, two French mathematicians, Blaise Pascal and Pierre de Fermat, developed the theory of probability, which is now widely used in determining insurance rates. The English astronomer Edmond Halley developed the first mortality table in 1693.

The Great Fire of London in 1666 led a doctor named Nicholas Barbon to open England's first fire insurance office. In 1752, Benjamin Franklin helped found the American Colonies' first mutual fire insurance company, the Philadelphia Contributionship for the Insurance of Houses from Loss by Fire. The colonies' first life insurance company was the Presbyterian Ministers' Fund, established in 1759. Both companies still exist.

The U.S. life insurance industry grew slowly in the first half of the 1800's. Many religious leaders condemned life insurance. They believed that insurance companies were wrong in placing a monetary value on human life. In 1840, the total value of life insurance policies in force was less than $5 million. By 1865, the total value was about $600 million.

Other types of insurance also grew rapidly beginning in the mid-1800's. A series of disastrous fires during the middle and late 1800's led to a rapid increase in the number of fire insurance policies. In 1864, the Travelers Insurance Company sold the first accident policy. It covered a Hartford, Connecticut, resident named James Bolter during a two-block walk from his home to the post office. The premium was 2 cents for the walk.

Greater regulation. During the mid-1800's, many states began to establish insurance departments and to pass laws regulating the insurance industry as a result of dishonesty by some companies. However, insurance laws frequently were not strictly enforced. During the late 1800's, the industry was plagued by scandals caused by the dishonest and irresponsible practices of many companies. In the early 1900's, many states passed laws that regulated the activities of insurance companies more strictly.

In 1935, Congress passed the Social Security Act to provide old-age benefits and unemployment compensation. In the early 1940's, during World War II, the federal government prohibited wage increases in most industries. Many employers then began to offer their employees various benefits, including group life and health insurance. In 1944, the Supreme Court of the United States ruled that insurance was interstate commerce and so was subject to federal regulation. However, the McCarran-Ferguson Act, passed by Congress in 1945, left regulatory power to the states.

During the late 1900's, more than 10 states had adopted no-fault automobile insurance plans. Many states also passed laws requiring insurance companies to provide potential buyers with complete information about the costs and benefits of their policies. In addition, companies in some states no longer could use such factors as sex, age, marital status, or place of residence to determine premium rates for certain types of insurance.

In 1996, the U.S. government enacted a law to guarantee workers the ability to get health insurance after they change or lose their jobs. Before the law was enacted, many insurance companies had refused to cover people who already had a health problem. As a result, many people could not get private health insurance, or could not move to a new job without losing their coverage. The law, which took effect in 1997, also called for raising the percentage of health insurance costs that self-employed people could deduct from their income when figuring their federal income tax. The law provided for raising this percentage from 30 to 80 percent by the year 2006. Despite this law, many millions of Americans still have no health insurance.

Insurance today. A number of problems involving insurance exist today. For example, new types of policies are needed to cover such risks as accidents in nuclear power plants, environmentally damaging oil spills, the disposal of hazardous wastes, the use of dangerous products, and dependence on computers. In social insurance, the United States and other countries face severe difficulties in providing future benefits mainly because of large increases in the proportion of elderly people. Rapid rises in the cost of medical care have also been a serious problem in the United States. In the 1990's, increased use of managed care plans dramatically slowed the rising cost of medical care. Nevertheless, the aging of the U.S population probably will put severe cost pressures on both private insurers and government programs, such as Medicare and Medicaid.

Natural disasters such as hurricanes, earthquakes, and tornadoes have caused big losses for both property owners and property insurers. Increased construction in areas where such risks as earthquakes and hurricanes are high has resulted in more extensive losses from natural disasters. State government insurance programs have been established in Florida and Hawaii to respond to hurricanes and in California to respond to earthquakes.

Some of the most significant recent developments in the insurance industry have included movements to combine companies into larger ones, to allow insurance

companies to engage in a wider variety of activities, and to enable them to provide their services around the world. As a result of these changes, the trend has been toward fewer but larger insurance organizations. Mergers have taken place not only between two or more insurance companies but also between insurance companies, stock brokerage firms, investment banks, and commercial banks. Dan R. Anderson

Related articles in *World Book* include:

Annuity
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Malpractice suit
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Product liability suit
Social security
Underwriting
Unemployment insurance
Workers' compensation

Outline

I. **Life insurance**
  A. Main kinds of life insurance
  B. Dividends
  C. How premiums are figured
  D. Buying life insurance
  E. Annuities
II. **Private health insurance**
  A. How private health insurance is provided
  B. Basic types of health insurance
  C. Other types of health insurance
III. **Property and liability insurance**
  A. Homeowners' insurance
  B. Automobile insurance
  C. Other kinds of property and liability insurance
IV. **Government insurance programs**
  A. Social insurance
  B. Other government insurance programs
V. **The insurance industry**
  A. Types of insurance companies
  B. How insurance is sold
  C. Government regulation
  D. Careers in the industry
VI. **History**

Questions

How did the practice of *underwriting* begin?
What do *actuaries* do? *Underwriters? Claims adjusters?*
How does whole life insurance differ from term life insurance? What are the advantages and disadvantages of each?
Why is automobile insurance one of the most important kinds of insurance?
What is the *law of large numbers?*
How can policyholders provide proof of both the ownership and the value of lost or damaged property?
How does an independent insurance agent differ from an exclusive agent?
What is a health maintenance organization?

Additional resources

Rubin, Harvey W. *Dictionary of Insurance Terms.* 4th ed. Barron's, 2000.
Vaughan, Emmett J. and Therese M. *Essentials of Insurance.* 2nd ed. Wiley, 2000.

Intaglio, *ihn TAL yoh* or *ihn TAHL yoh,* is an artistic process in which a design is carved into the surface of a material. Intaglio printmaking involves reproducing that design with ink repeatedly. The artist first cuts or carves lines or shapes into a plate, most often a sheet of copper. Ink is then applied over the plate's surface and allowed to seep into the recessed grooves. Paper or other absorbent material is laid on top of the plate. Through direct pressure applied manually or through a printing press, the ink is transferred from the plate to the paper. The process creates a mirror image of the design made in the plate. A printmaker can *pull* (print) many identical images from the plate before the design starts to wear.

In sculpture and the decorative arts, *intaglio* refers to a design or inscription carved into a three-dimensional surface. Intaglio techniques have been used in coins, seals, and medals. Medha S. Patel

Related articles in *World Book* include:

Cameo
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Photoengraving and photolithography
Printing (Recess printing)
Relief
Sculpture (Kinds of sculpture)

Integer, *IHN tuh juhr,* is a number. The most familiar integers are the counting numbers, such as 1, 7, 28, and 105. The complete set of integers also includes zero and such numbers as -1, -7, -28, and -105. For every positive integer, there is a corresponding negative integer that, when added to the positive integer, gives a sum of zero. For example, $5 + (-5) = 0$. Integers can be added, subtracted, multiplied, and divided.

Most mathematics involves the use of integers, and some mathematical calculations would be impossible without them. Integers also help describe certain everyday situations. For example, temperatures can be above or below zero. Thomas P. Carpenter

Integrated circuit. See Computer chip; Transistor.

Integration. See Segregation.

Intellectual property refers to *intangible* products of human creativity over which people or groups exercise legal control. Something that is intangible cannot be held or touched. Works protected by intellectual property laws include books, computer programs, designs, inventions, motion pictures, music, paintings, symbols, and trade secrets. Rules for granting intellectual property protection differ from country to country, though international agreements have set many common guidelines.

There are many forms of intellectual property protection. *Copyrights* protect authors and artists against unauthorized copying and distribution of their works. *Patents* grant inventors exclusive rights over their inventions for a limited period of time. Companies may obtain protection for their *trademarks*—that is, the words or symbols they use to identify their products.

The evolution of computer and telecommunications technologies has led to difficult questions in the field of intellectual property protection. The Internet and other communications media make it possible to reproduce and send intellectual property around the world instantaneously and at very low cost. As a result, it has become extremely difficult in many cases to protect intellectual property against unauthorized use.

Many people argue that intellectual property protection should be reduced to promote greater distribution of knowledge and the benefits of new technology. Others believe that strict protections are necessary to encourage creative activity. Frederick M. Abbott

See also Copyright; Patent; Trademark.

Intelligence is often defined as the ability to adapt to the environment. Intelligent people can better understand what goes on around them so that they can respond to it in an effective way. Intelligent people are also good at learning various kinds of information,

which they then can use to their advantage or for others' benefit. In school, for example, highly intelligent students might learn history, mathematics, or science more effectively than would less intelligent students. Outside of school, intelligent people might better learn the rules of society or how to perform well on their job.

This article discusses human intelligence. For information about intelligence in other animals, see *A table of animal intelligence* in Animal. For a discussion of intelligence in machines, see Artificial intelligence.

The study of intelligence. Scientists use a variety of methods to study intelligence. Some scientists carefully measure people's reaction times to various kinds of problems. They seek to understand the mental processes and strategies people use in solving such problems. Other scientists directly study the functioning of the brain. They use imaging techniques to take a picture of the brain as it works on solving a problem. For example, researchers have found that the brains of more intelligent people use less glucose for fuel compared to other people when solving certain kinds of problems. They believe that more intelligent people can solve the problems more efficiently and with less effort.

Theories of intelligence. An early attempt to understand intelligence was made by the British scientist Francis Galton. In 1893, Galton suggested that the basis of intelligence is sensitivity to physical *stimuli* (forces that trigger a reaction). He measured intelligence by testing people's vision, hearing, and physical strength.

The French psychologist Alfred Binet used a different approach. In 1905, Binet and his colleague Theodore Simon devised a test to measure complex thinking and judgment skills. The test helped identify students who were less successful in school, and it became the basis for many future ideas about intelligence and ways to measure it. Binet's approach was more concerned with measuring intelligence than with stating exactly what it is. Other scientists have concentrated on understanding the nature of intelligence and determining if there is more than one kind of intelligence.

In 1904, the English psychologist Charles E. Spearman proposed that underlying intelligence are two kinds of abilities: (1) a general ability common to all tasks requiring intelligence and (2) specific abilities that differ from task to task. Spearman emphasized the importance of the general ability, because it suggested that more intelligent people could be distinguished from less intelligent people on the basis of a single factor.

During the 1930's and 1940's, however, the American psychologist Louis L. Thurstone argued that intelligence cannot be understood just in terms of a single factor. He suggested that intelligence consists of at least seven primary mental abilities, such as *verbal comprehension ability* (the ability to understand word meanings), *number ability* (the ability to do basic mathematics), and *spatial ability* (the ability to visualize things in the mind). Another American psychologist, Howard E. Gardner, suggested in the 1990's that there are eight distinct intelligences, such as linguistic intelligence, spatial intelligence, musical intelligence, and *interpersonal intelligence* (the ability to get along with others). In contrast, psychologist Robert J. Sternberg argued that there are only three relatively distinct aspects of intelligence: (1) the ability to analyze ideas, (2) the ability to create or come up with one's own ideas, and (3) the ability to apply ideas in one's everyday life.

The roles of heredity and environment. Many scientists examine the relative roles of heredity and environment in contributing toward individual differences in intelligence. Researchers have used several different methods to assess the roles of each.

In the 1990's, the American psychologist Thomas J. Bouchard studied identical twins raised apart from birth or early childhood. Because such twins share identical genes but not environment, scientists presume all differences between them are caused by the environment. Bouchard found that a major portion of individual differences in intelligence appears to be due to genetic factors. Other scientists attempt to identify the genes responsible for intelligence. In 1998, the American psychologist Robert Plomin reported that he had identified genes that account for extremely small portions of what makes people differ in intelligence.

Most scientists agree that both heredity and the environment contribute to individual differences in intelligence. Research on this topic has produced two curious findings, however. First, the influence of heredity appears to increase as people get older. That is, the environment seems to become less important with age as a source of individual differences in intelligence. Second, it appears that environmental factors within families produce greater differences in intelligence than do environmental differences between families. Children within the same family are treated by parents in different ways and may have different friends. These differences, rather than variations in the way parents in different families raise their children, appear to lead to most of the differences in the children's intelligence.

Different groups of people, such as ethnic groups, show different average levels of intelligence as measured by standard tests of intelligence. Scientists, however, do not understand these differences well and find them difficult to study. Research suggests that group differences are more likely due to environment rather than heredity. But scientists disagree about which factor is more important in determining a person's intelligence.

Modifying intelligence. Educators and others have developed programs for infants, children, and adults that attempt to raise individual levels of intelligence. A few programs have achieved small gains in measured intelligence. Challenging work in adulthood tends to help increase or at least preserve intelligence. Thus, the best way to maintain and even boost intelligence seems to be to use it and to challenge it.

Robert J. Sternberg

Related articles in *World Book* include:

Binet, Alfred
Dewey, John
Gifted children
Intelligence quotient
Learning
Learning disabilities
Mental retardation
Testing
Thorndike, Edward Lee
Thurstone, Louis Leon

Additional resources

Eysenck, Hans J. *Intelligence.* Transaction Pubs., 1998.
Richardson, Ken. *The Making of Intelligence.* Columbia Univ. Pr., 2000.
Sternberg, Robert J., ed. *Encyclopedia of Human Intelligence.* 2 vols. Macmillan, 1994.
Trefil, James. *Are We Unique?* Wiley, 1997.

Intelligence quotient, also called IQ, is a number used to indicate a person's level of intelligence com-

pared to other people. The average IQ is set at 100 for convenience. In reality, any number could be used as the average. If a person has an IQ twice as high as another person's, however, it does not mean that the first person is twice as intelligent.

People with IQ's below 70 may be labeled as *mentally retarded,* but only if they also show deficits in everyday *adaptive behavior*—that is, the ability to adjust to events in their daily lives. People with IQ's over 130 may be labeled as *intellectually gifted,* but usually the individuals must show other kinds of outstanding performances to receive this label.

Calculating IQ. Intelligence quotients are determined from tests of intelligence. These tests measure learning, memory, judgment, reasoning, and problem-solving skills. For example, a test might ask an individual to define a word, or the test might ask an individual to solve a word problem, such as *high* is to *low* as *black* is to? Or it might ask what number would come next in the following series of numbers: 18, 15, 12, 9, ?

Psychologists originally calculated intelligence quotients in a way that actually produced a quotient. They started with a *mental age,* which is the average age of a child who performs at a certain level. Thus, if an average 12-year-old answers 20 items correctly on a test of intelligence, then 20 correct answers corresponds to a mental age of 12. Then psychologists considered *chronological age,* the length of time a person has lived. If a child is 10 years old, that child's chronological age is 10. The IQ score was calculated from the following formula:

IQ = ([Mental age] ÷ [Chronological age]) ×100.

Thus, someone with a mental age of 10 and a chronological age of 10 has an IQ of 100. Someone with a mental age of 8 and a chronological age of 10 has an IQ of 80. Today, testers rarely compute IQ's in this way. Increases in people's mental age do not occur evenly across age levels. The procedure for calculating IQ only works for people up to about age 16 to 18. People's mental age increases at a slower rate as they grow older until it stops increasing altogether and may even decrease.

Some intelligence tests produce just a single IQ score, but most tests produce multiple scores. For example, one kind of test produces an overall IQ score, but also scores for verbal IQ and performance IQ. The verbal IQ is based on problems largely involving words. The performance IQ is based largely on tasks that require manipulation of puzzlelike materials.

Problems of intelligence testing. Critics have pointed out several problems with intelligence testing. The tests may not be equally fair for all groups. For example, someone who grows up speaking a language other than English will clearly face a disadvantage on a test given in English. Educators and psychologists have attempted to create tests that reduce or even eliminate the effects of culture and language, but no such tests have been completely successful.

There is also a risk that a person's score on an IQ test will give the impression that the person's abilities cannot vary and lead to the person being labeled. But labels can be misleading because people's IQ scores do fluctuate.

In addition, psychologists have many theories of intelligence, and not all of them agree that a single test can accurately measure it. Many believe that IQ scores represent only part of the full range of a person's intellectual abilities. Robert J. Sternberg

See also Intelligence; Testing.

Intelligence service is an agency that chiefly gathers and evaluates information for a country's political and military leaders. These leaders use the evaluated information, called *intelligence,* to shape military policy, fight wars, and conduct economic and other foreign relations.

There are generally two kinds of intelligence services. One kind is a *foreign intelligence service,* which gathers information about foreign countries and institutions, analyzes such information, or both. Such a service may also engage in *covert operations,* in which it secretly tries to influence events in foreign countries. The other type of intelligence service is an *internal security service.* It seeks to neutralize hostile intelligence services operating within the country and detect and stop the activities of terrorist groups.

Intelligence services get information from a variety of sources. Aircraft and artificial satellites produce detailed images. Space, air, and ground systems can monitor electronic signals. Intelligence services also recruit agents in foreign governments and other institutions. In addition, they rely on such "open sources" as books, magazines, newspapers, and TV broadcasts.

In nondemocratic countries, the internal security service often works with the police and other institutions to eliminate dissent and to imprison or kill dissenters. The agency may be part of a larger service that also conducts foreign intelligence operations.

The major United States foreign intelligence services are the Central Intelligence Agency, the Defense Intelligence Agency, the National Reconnaissance Office, and the National Security Agency/Central Security Service. The nation's internal security service is the Federal Bureau of Investigation (FBI). In addition, each of the U.S. military services operates one or more intelligence organizations. Jeffrey T. Richelson

See also Central Intelligence Agency; Espionage.

Intelsat, Ltd., is a private corporation that provides international satellite communications services. Intelsat maintains a network of communications satellites that enables telephone messages, television signals, and other forms of communication to be sent worldwide almost instantly.

The history of Intelsat, Ltd., began in 1961, when United States President John F. Kennedy invited all nations to join the United States in forming an alliance to develop the potential of communications satellites. The organization was established in 1964 as the International Telecommunications Satellite Consortium (INTELSAT). In 1965, it launched its first satellite, Early Bird. INTELSAT changed the last word of its name from *Consortium* to *Organization* in 1973. In 2000, the governments of the 144 member countries of INTELSAT agreed to privatize the organization in 2001. The initial investors in the new corporation, Intelsat, Ltd., were major telecommunications companies from those member countries.

Intelsat owns its satellites and the ground stations from which they are controlled. The transmitting and receiving equipment in each country is owned, in most cases, by companies Intelsat serves in that country. A modern Intelsat satellite can carry more than 100,000

telephone circuits and more than 70 television broadcast signals. Intelsat has headquarters in Hamilton, Bermuda. Critically reviewed by Intelsat, Ltd.

See also **Communications satellite.**

Interactive program is a computer program that modifies its outcome in response to input from the computer user. A computer game is a type of interactive program. The most sophisticated games rarely respond in the same way twice during a single session of play.

Many educational and instructional programs serve as "patient teachers," guiding their students through repetitive sessions of drill and practice. Some include games and exercises to reinforce the lessons. Interactive programs have been especially effective in teaching mathematics and foreign languages. Electronic versions of traditional printed media, such as encyclopedias, may include interactive instructional programs. Keith Ferrell

Intensive care unit is a section of a hospital in which highly skilled health-care workers provide constant attention and extensive treatment for critically ill patients. There are several specialized types of intensive care units, often called ICU's. The main types are *medical ICU's,* which care for adults with critical illnesses; *surgical ICU's,* whose patients have had or are being prepared for major operations; *pediatric ICU's,* for babies and children; and *coronary care units* (CCU's), for adults with heart problems.

An ICU patient who cannot eat or drink may receive a nutrient solution *intravenously* (by vein). The solution of water mixed with sugars and salts may also include vitamins, *amino acids* (the building blocks of proteins), fats, or medicines. A bag of the solution hangs on a pole, and the liquid drips through tubes into the patient's vein. Another tube may go through the nose and throat into the stomach.

If the patient cannot breathe, a respirator alongside the bed does the breathing. The respirator is connected to the patient through tubing, which enters the windpipe through the nose, mouth, or a surgically created hole in the neck. Special patches that sense the heartbeat are attached to the patient's skin. They are wired to a screen that shows the pattern of heartbeats and the number of beats per minute. If the heartbeat becomes irregular, alarms sound to summon health-care workers. Alarms also go off if fluids stop going into the patient's vein, if the respirator fails, or if there is difficulty with any other equipment. Elizabeth Mary Lutas

Intercom is a system for communicating between a number of points that are close to each other. Intercom systems are used in offices, factories, and other places where quick, easy voice communication is needed. The *electrical* intercom is a simple type of telephone system. It consists chiefly of an amplifier and a number of loudspeakers placed at the communication points. The voice of the person speaking into a microphone at a central station is carried to the loudspeakers. Stanley R. Alten

Intercontinental ballistic missile. See **Guided missile** (Ballistic missiles).

Interdependence. See **Cooperative; International relations; Trade.**

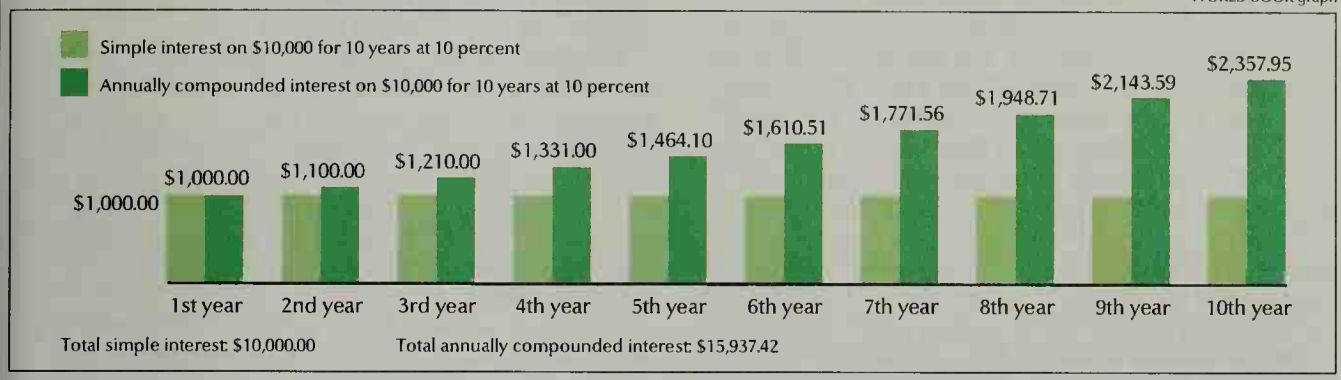
Yoav Levy, Phototake

In an intensive care unit, skilled health professionals give patients constant care. Advanced equipment monitors body systems and provides treatment that may help a patient survive a life-threatening illness.

Simple and compound interest

The chart below compares simple interest and interest that is compounded annually. Simple interest is paid only on the money borrowed or saved. Compound interest is paid on both the amount borrowed or saved and the accumulated interest, and it grows faster than simple interest.

WORLD BOOK graph



Interdependence of animals. See Ecology; Symbiosis; Ant (Life in an ant colony).

Interdependence of plants. See Ecology.

Interest is the price paid to lenders for the use of their money. Interest is figured as a percentage of the amount of money borrowed. For example, a borrower who is charged 12 percent interest would pay $12 a year in interest for every $100 of the loan. Interest is based on the idea that lenders are entitled to a return on their investment. This pays them for giving up their right to use the money for a period of time or to make a profit in other ways.

Interest plays an essential part in commerce. Businesses, governments, and consumers borrow and lend money, and thus they pay and receive interest. Businesses borrow money to buy new machinery or to build new factories. They also raise money by selling bonds to the public. Investors who purchase the bonds are paid interest by the businesses that sold them. Businesses pay interest with higher earnings made possible by the borrowed money. At times, one business invests in another and receives interest on its loan. Governments borrow to make up the difference between the money they spend and the funds they collect in taxes. A government receives interest on money it lends, such as on loans to people who want to establish a business. Consumers pay interest if they borrow to buy a home or an automobile. When people deposit money in a savings account, they are lending funds to a bank or a savings and loan association. Therefore, they receive interest.

People or businesses who lend money have incomes greater than their expenditures, so they let others use their money. Instead of hoarding their surplus funds, lenders use it to earn more money through interest.

Borrowers pay interest so they can make purchases that they could not afford if they had to pay immediately. Suppose that a family wishes to buy a house but has not saved enough to pay the entire cost at once. Instead of waiting until the total amount has been saved, the family can take out a mortgage from a bank or another lending institution. The family can then live in the house while repaying the loan in monthly installments. When consumers buy goods or services on credit, they actually are borrowing money by promising to pay by a future date. If the purchase is made on a *revolving charge account,* the consumer pays in monthly installments and is charged interest on the unpaid balance on the account.

Wise consumers learn about the interest rates they agree to pay. A few merchants may try to make a profit by selling items at low prices but charging a high rate of interest on credit payments. In some cases, consumers pay a higher interest rate for credit from a store than they would for a loan from a bank.

Types of interest

The most common types of interest are (1) simple, (2) compound, and (3) discount.

Simple interest is paid only on the *principal,* the amount of money that is borrowed. A person who borrows $1,000 for two years at 10 percent simple interest would pay a total of $200 in interest. The amount of interest would be $100 (10 percent of $1,000) for the first year and $100 for the second year.

Compound interest is computed on both the principal and the accumulated interest. A person who borrows $1,000 for two years at 10 percent interest that is compounded annually would pay a total of $210 in interest. The amount of interest would be $100 (10 percent of $1,000) at the end of the first year and $110 (10 percent of $1,100) at the end of the second year. Thus, a two-year $1,000 loan would cost $10 more at 10 percent annually compounded interest than it would at 10 percent simple interest. Interest may also be compounded at other intervals, including daily, monthly, quarterly, and semiannually.

Discount interest is subtracted from the principal before the borrower receives the money. The amount subtracted depends on the *discount rate.* For example, a person who borrows $1,000 at a discount rate of 10 percent would receive only $900 ($1,000 minus 10 percent). However, the borrower would have to repay the entire amount of $1,000. The borrower would pay $100 in interest for the use of only $900. With discount interest, a borrower agrees to actually pay a higher rate of interest than set forth. In the above case, the actual interest rate is 11.11 percent ($100 divided by $900).

How interest is calculated

In the United States, almost all savings establishments pay interest that is compounded daily. The two most common methods of crediting such interest are (1) day of deposit to day of withdrawal and (2) day of deposit to

end of interest period. But most savings institutions do not credit interest to an account until the end of the interest period. Others credit interest semiannually.

Day of deposit to day of withdrawal. This is the most common method of crediting interest, and it pays the highest amount. Suppose that you deposit $100 in a savings account one week and add $50 to the account each week for two weeks. At the end of the first week, you would have earned seven days' interest on the original $100. In the second week, you would earn seven days' interest on $150 plus accumulated interest. In the third week, you would earn seven days' interest on $200 plus accumulated interest. If you withdrew some of the money from the savings account, interest would be compounded daily on the remaining amount.

Day of deposit to end of interest period. This method involves calculating interest from the day the money is deposited until the final day of the interest period. Interest is compounded only on the amount in the account on the last day, and only for the number of days the money was in the account. Suppose you have a $300 savings account but withdraw $100 before the end of the interest period. You would receive interest on only $200 for the number of days the $200 was on deposit.

Why interest rates vary

There are a number of loan markets, including those for consumer loans, home mortgages, corporate bonds, state and local government bonds, and foreign loans. Each loan market has its own interest rate, which rises and falls during a period of time. The interest rates in these markets, like the prices of food and other products, depend on the relationship between supply and demand. Interest rates rise if (1) the demand for loans increases or (2) the amount of money available for loans decreases. Generally, when interest rates are low, people are eager to borrow because loans cost less than at other times.

Interest rates fall if (1) the demand for loans decreases or (2) the amount of money available for loans increases. In most cases, when interest rates are high, lenders are eager to make loans because they earn a bigger profit. At the same time, however, loans cost more, and so people are less likely to borrow.

Supply and demand, in turn, are affected by several factors, such as (1) government policy, (2) inflation, (3) economic activity, (4) the length of a loan, and (5) the degree of risk.

Government policy. Governments influence interest rates by increasing or decreasing the amount of money available for loans. A government normally does so through the nation's *central bank,* which is a government agency in most countries. The Federal Reserve System is the central banking organization of the United States. The system influences interest rates partly by requiring all United States banks to set aside a certain percentage of their deposits on reserve. The banks may use the remaining amount for loans.

One way in which the Federal Reserve controls the amount of money available for loans is by increasing or decreasing the reserve requirement. It follows a *loose money policy* when it requires banks to keep a lower percentage of money on reserve. This action increases the amount of money available for loans and contributes to lower interest rates. The Federal Reserve follows a *tight money policy* when it increases the banks' reserves. This action decreases the money available for loans and contributes to higher interest rates. See **Money** (The role of the Federal Reserve System).

Inflation. During a period of *inflation,* when prices are increasing throughout a nation's economy, any given amount of money buys less than it did before. At such times, lenders try to protect their incomes by raising interest rates. In addition, many people are less able to save money, and so lending institutions may have less money to lend. Therefore, the amount available for loans decreases and interest rates rise. See **Inflation** (Monetary policy).

Economic activity. When the economic activity of a nation increases—that is, when consumers buy more than previously—businesses expand their production capacity. They might buy new equipment or increase the supply of raw materials they have on hand. To finance this expansion, they borrow. Therefore, the demand for loans increases and interest rates also rise. When the economy slows down—that is, when consumers buy less—businesses produce less and borrow less. The demand for loans drops, and interest rates fall.

Length of a loan. Money can be borrowed for one day or for many years. Banks often lend each other money for only a few days. However, mortgages may be issued for 20 or 30 years. *Short-term loans* are for a year or less. *Intermediate-term loans* are for one to five years, and *long-term loans* for longer than five years.

Interest rates for short-term loans are generally lower than rates for long-term loans for several reasons. Lenders believe they can foresee future economic conditions more accurately for a short period than a longer one. As a result, they consider short-term loans safer.

Lending institutions make less profit on short-term deposits than on long-term ones. Therefore, banks and savings and loan associations pay a higher rate of interest to customers who promise to leave their money in an account for a specified period of time.

Degree of risk. Interest rates can be influenced by the *creditworthiness* of the borrower—that is, the probability that the borrower will repay the loan. For example, the United States government ranks as an excellent credit risk. Therefore, the government can borrow at lower interest rates than many other borrowers. A company with a long record of high profits can borrow more cheaply than a company with an unproven record. However, certain kinds of loans involve standard interest rates. All borrowers must pay the same rate, regardless of their creditworthiness.

How interest rates reflect economic conditions

Certain types of interest rates reflect the general condition of the United States economy. These rates, which include the (1) prime rate, (2) discount rate, and (3) federal funds rate, influence other types of interest rates.

The prime rate is the interest rate that banks charge their best commercial customers for short-term loans. The prime rate often serves as a guide for other interest rates. Like other rates, the prime rate can vary greatly over a period of time. In late 1980, the prime rate in the United States reached 21 $\frac{1}{2}$ percent, the highest level in the nation's history up to that time. In 1972, some banks

in the United States charged only 4 ¾ per cent.

The discount rate is the rate that banks must pay when they borrow money from the Federal Reserve System. This rate can affect the prime rate. If the Federal Reserve raises its discount rate, banks tend to charge their own commercial customers higher interest rates. However, the discount rate may also be affected by the prime rate.

The federal funds rate is the interest rate that member banks of the Federal Reserve charge each other for short-term loans. Member banks that do not have a sufficient amount on reserve borrow from banks with a surplus. Most of these loans are made for only one day. The federal funds rate is an important indicator of the tightness or looseness of the loan market.

Regulation of interest rates

In the United States, the federal and state governments regulate borrowing and lending. The Consumer Credit Protection Act of 1968, often called the Truth in Lending Act, requires lenders to show borrowers the entire loan contract, including the annual interest rate. In this way, consumers can calculate the total cost of a loan and compare the costs charged by various lenders.

From 1980 to 1986, the federal Depository Institutions Deregulation Committee wrote regulations to remove controls on maximum interest rates that banking and savings institutions could pay depositors. The committee disbanded in March 1986, and federally imposed ceilings on the interest rates of most consumer bank accounts were eliminated. Since then, most interest rates have been based chiefly on competitive market forces. However, the federal government continues to ban the paying of interest on regular commercial checking accounts. Anticipating deregulation, banks began experimenting in the mid-1980's with accounts that offered high interest yields in a savings account format.

Some states have laws that limit the interest rates on certain kinds of consumer loans. These *usury laws* are intended to prevent lenders from taking unfair advantage of borrowers who may be in great financial need. Some states also limit interest on savings deposits.

History

Until the 1500's, most people opposed the charging of interest on loans. In fact, they believed that charging interest for any reason was wrong and was the same as *usury* (excessive payment for the use of money).

In Biblical times, all payments for the use of money were forbidden. The Israelites considered lending money without interest to be a duty that the rich owed the poor. The ancient Greek philosopher Aristotle thought interest caused people to suffer because they needed money. During the Middle Ages, the Christian Church condemned the charging of interest as a sin. People found guilty of usury were whipped, deprived of their possessions, or even banished.

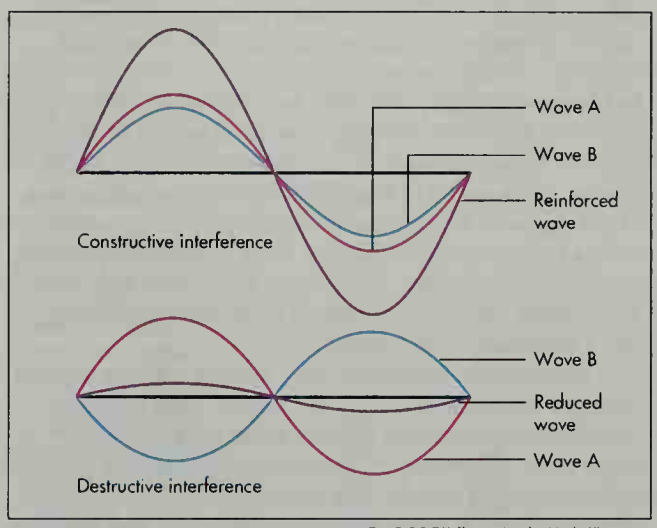
In 1545, King Henry VIII of England changed his nation's laws to allow some forms of interest. By the 1700's, charging interest had been accepted as a fair business practice. Since that time, most disagreements about interest have concerned the maximum rates that lenders should be permitted to charge. Frank J. Bonello

See also **Credit; Installment plan; Mortgage; Usury.**

Interference is an effect caused by two waves of the same kind passing through the same space. It occurs with all kinds of waves, including sound waves, light waves, radio waves, and water waves. Interference causes the intensity of waves to be stronger in some locations than in others. The term *interference* also refers to any overlapping of radio and television signals with unwanted electromagnetic waves.

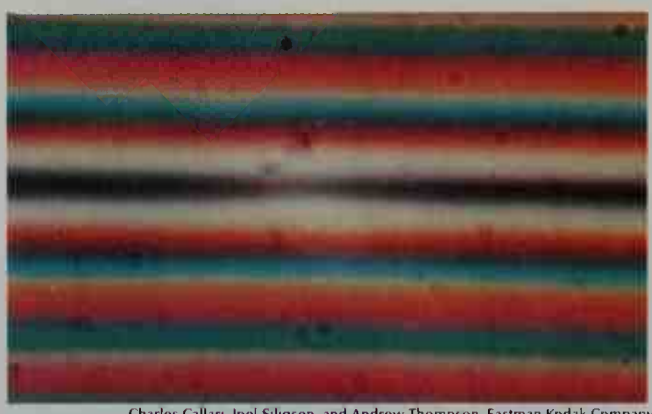
The interference of sound waves can be demonstrated with two speakers connected to the same source of sound. If a listener is sitting at the same distance from both speakers, the crests of the two sound waves reach the listener simultaneously. The waves arrive *in phase* with each other—that is, the crests of the two waves and their low points coincide. As a result, the sound heard by the listener is four times louder than that produced by either speaker alone. This effect is called *constructive interference*.

If the listener were to sit closer to one speaker than the other, the crests of the two sound waves would reach the listener at different times. The waves might then arrive *out of phase*. If they arrived exactly half a cycle out of phase, the crests of one wave would coincide with the low points of the other. The waves would



WORLD BOOK illustration by Linda Kinnaman

Interference occurs when two waves of the same kind pass through the same space. In constructive interference, A and B combine to form a reinforced wave. In destructive interference, the difference between A and B forms a reduced wave.



Charles Callari, Joel Siligson, and Andrew Thompson, Eastman Kodak Company

Interference fringes are colored bands produced by the interference of light waves. They appear on a viewing screen when a beam of light shines through lines scratched on glass.

cancel each other, and so no sound would be audible to the listener. This effect is known as *cancellation* or *destructive interference.*

Similar interference occurs with light waves. The effects can be observed in a simple experiment. Coat a glass plate with paint and then scratch two thin lines very close together. Direct a beam of light at the lines and allow the emerging light to fall on a viewing screen. The light appears as a series of colored bands called *interference fringes.* Each band will have bright and dark fringes. The bright fringes are areas where light waves from the lines arrive in phase and reinforce each other. The dark fringes correspond to areas where the waves arrive out of phase and cancel each other.

Research on interference has helped scientists understand the wave nature of light and the structure of atoms and molecules. It also has resulted in various practical applications. For example, the interference of light waves aids the production of three-dimensional images called *holograms* (see Holography). It is also used to control radio transmission and reception. Radio stations sometimes beam radio waves from several antennas in a row. The resulting interference pattern increases or decreases the signal intensity in certain directions. Similarly, radar waves may be sent in varying phases from different antennas. The resulting interference enables radars to spread signals in many directions without moving. Jack Feinberg

Interferometer, *IHN tuhr fuh RAHM uh tuhr,* is an instrument that uses the interference of waves to make precise measurements. It can measure very small distances, or changes in the density and other properties of substances. Some interferometers employ sound waves or radio waves. But the most common types use waves of visible light. This article deals with light interferometers. For information on radio interferometers, see Telescope (Radio telescopes).

A simple light interferometer divides a beam of light into two beams and brings the beams back together again. The recombined beams shine on a screen or other object, forming an *interference pattern* (a series of bright and dark bands). For an explanation of why interference patterns appear, see Interference. The pattern reveals any differences in the routes taken by the two beams. Scientists analyze these differences to make their measurements. For example, one beam might be reflected from a mirror being tested for smoothness while the other is reflected from a mirror known to be smooth. Any imperfection in the test mirror, such as a microscopic hill or valley, would produce a distortion in the interference pattern. Some interferometers can monitor the rapidly changing temperature and density inside a flame. Interferometers also can measure tiny distances, such as the amount a plant grows in a second.

In the early 1800's, the English scientist Thomas Young demonstrated the wave nature of light by using the principle of interference. In 1881, the American physicist Albert A. Michelson devised an interferometer to measure the earth's motion. Jearl Walker

See also Light (Interference; illustration: The behavior of light); Michelson, Albert A.

Interferon, *IHN tuhr FIHR ahn,* is a protein produced by various body cells in response to viral infections. Interferons protect other cells from becoming infected by the virus. Interferons also are produced if certain harmful chemicals and drugs enter the body. Researchers have tested interferons in the treatment of many diseases, including certain cancers.

There are three types of interferons: *alpha, beta,* and *gamma.* Alpha and beta interferon are produced by many types of cells throughout the body. Gamma interferon, also called *immune interferon,* is produced by white blood cells called *lymphocytes.* All three interferons are released by the cells within a few hours after a viral infection occurs. They bind to the cells that border the infection and prevent the virus from spreading. Some interferon enters the bloodstream, where more is produced to help protect the rest of the body. In addition to its antiviral properties, gamma interferon acts as a signal molecule in triggering an *immune response* to many kinds of infections. An immune response is the process by which the body produces disease-fighting cells and antibodies. See Immune system.

Interferon was jointly discovered in England by the Scottish virologist Alick Isaacs and the Swiss virologist Jean Lindenmann in 1957. In the late 1960's, Kari J. Cantell, a Finnish virologist, developed techniques for obtaining interferons from human white blood cells. Today, scientists use techniques of molecular biology to manufacture large quantities of interferons.

Interferons are used to treat hepatitis C, hairy-cell leukemia, and *Kaposi's sarcoma,* a cancer often found in people who have AIDS. They also may be useful against skin cancer and certain viral diseases, including hepatitis B. Neal R. Pellis

See also AIDS (Treatments); Genetic engineering (Uses of genetic engineering).

Interior, Department of the, is an executive department of the United States government that works to conserve and develop the nation's natural resources. It also manages the country's national parks and administers programs for American Indians who live on reservations.

The secretary of the interior, a member of the president's Cabinet, heads the department. The secretary is appointed by the president with the approval of the U.S. Senate.

Functions. The Department of the Interior works to conserve the nation's mineral, water, and wildlife resources and to protect the environment. It manages hundreds of millions of acres of federal land, including national parks, national monuments, and federal wildlife refuges.

The department also controls the development of natural resources on federal land and in offshore areas. It sells individuals and private companies the right to use federal land for grazing, logging, mining, and other commercial purposes. It also leases federal offshore areas for mining and for drilling for oil and natural gas. In addition, the department helps manage and protect water resources in the Western States.

National Park Service

The seal of the Department of the Interior

National Park Service

The Interior Department's Headquarters, *shown here,* are on C Street in the northwest section of Washington, D.C.

It administers programs throughout the nation for restoring land after *strip* (surface) mining.

On Indian reservations, the Interior Department manages law enforcement, welfare, education, and other programs. It also serves as the trustee for the Indians' tribal lands. Outside the 50 U.S. states, the department helps administer American Samoa, Guam, the Virgin Islands, and other territories and possessions of the United States.

History. The Department of the Interior was established in 1849. It took over many duties that had been performed by other federal departments and agencies. The law creating the department transferred to it the General Land Office, the Office of Indian Affairs, and the Pension Office. The department also received such duties as conducting the U.S. census and issuing patents, jobs that were later transferred to the Department of Commerce.

Over the years, Congress gradually changed the role of the department from that of general housekeeper for the federal government to that of guardian of the country's natural resources. Congress created other executive departments and independent agencies to take over many of the duties of the Interior Department.

Some important agencies of the Department of the Interior

Bureau of Indian Affairs promotes the welfare of American Indians; enforces the law and runs schools on some reservations; provides job training and employment services for Indians.

Bureau of Land Management manages U.S. public lands, most of which are located in the Western States and Alaska.

Bureau of Reclamation manages water resources in the Western States.

Fish and Wildlife Service helps conserve the nation's birds, mammals, fish, and other wildlife; manages the national wildlife refuges.

National Park Service manages the National Park System, including national parks, national monuments, and national historic sites.

United States Geological Survey conducts studies of public lands and offshore areas to gather information on natural resources and to identify areas that may be affected by such natural hazards as earthquakes, floods, and volcanoes.

Critically reviewed by the Department of the Interior

Related articles in *World Book* include:
Fish and Wildlife Service
Flag (picture: Flags of the United States government)
Geographic Names, United States Board on
Geological Survey, United States
Indian Affairs, Bureau of
Land Management, Bureau of
National Park Service
Reclamation, Bureau of

Secretaries of the interior

Name	Took office	Under president
Thomas Ewing	1849	Taylor
T. M. T. McKennan	1850	Fillmore
A. H. H. Stuart	1850	Fillmore
Robert McClelland	1853	Pierce
Jacob Thompson	1857	Buchanan
Caleb B. Smith	1861	Lincoln
John P. Usher	1863	Lincoln, A. Johnson
* James Harlan	1865	A. Johnson
Orville H. Browning	1866	A. Johnson
Jacob D. Cox	1869	Grant
Columbus Delano	1870	Grant
* Zachariah Chandler	1875	Grant
* Carl Schurz	1877	Hayes
* Samuel J. Kirkwood	1881	Garfield, Arthur
Henry M. Teller	1882	Arthur
* L. Q. C. Lamar	1885	Cleveland
William F. Vilas	1888	Cleveland
John W. Noble	1889	B. Harrison
Hoke Smith	1893	Cleveland
David R. Francis	1896	Cleveland
Cornelius N. Bliss	1897	McKinley
Ethan A. Hitchcock	1898	McKinley, T. Roosevelt
James R. Garfield	1907	T. Roosevelt
Richard A. Ballinger	1909	Taft
Walter L. Fisher	1911	Taft
Franklin K. Lane	1913	Wilson
John B. Payne	1920	Wilson
* Albert B. Fall	1921	Harding
Hubert Work	1923	Harding, Coolidge
Roy O. West	1928	Coolidge
Ray L. Wilbur	1929	Hoover
* Harold L. Ickes	1933	F. D. Roosevelt, Truman
Julius A. Krug	1946	Truman
Oscar L. Chapman	1949	Truman
Douglas McKay	1953	Eisenhower
Frederick A. Seaton	1956	Eisenhower
Stewart L. Udall	1961	Kennedy, L. B. Johnson
Walter J. Hickel	1969	Nixon
Rogers C. B. Morton	1971	Nixon, Ford
Stanley K. Hathaway	1975	Ford
Thomas S. Kleppe	1975	Ford
Cecil D. Andrus	1977	Carter
James G. Watt	1981	Reagan
William P. Clark	1983	Reagan
Donald P. Hodel	1985	Reagan
* Manuel Lujan, Jr.	1989	G. H. W. Bush
Bruce E. Babbitt	1993	Clinton
Gale A. Norton	2001	G. W. Bush

*Has a separate biography in *World Book*

Larry N. Deutsch ASID

Effective interior design creates indoor spaces that are attractive, comfortable, and functional. This formal living room is designed in a traditional style. The room combines furniture, drapes, wallpaper, carpeting, lighting, and ornaments and plants to establish a feeling of quiet luxury.

Interior design

Interior design, sometimes called *interior decoration,* is the art of creating rooms and other indoor areas that are attractive, comfortable, and useful. Interior design involves the careful selection of items to suit the purpose and overall mood of the area. Many items help create an interior, including furniture, lighting, paint, wall coverings, carpet, and such window treatments as blinds or draperies.

Most people think of interior design in terms of decorating the rooms of a house or apartment. But professional interior designers also plan and create interiors for hotels and motels, hospitals, libraries, office buildings, post offices, schools, and stores. They also design the indoor areas of banks, churches and synagogues, theaters, and transportation terminals. Professional designers even plan the interiors of airplanes, automobiles, and ships.

Whether a designer is a professional planning a hotel lobby or a nonprofessional planning a living room, interior design involves a problem-solving process. In developing a *design plan* for an interior, the designer must determine all the activities that may take place in the area. The designer must also consider who will use the area and what the overall mood should be. Each interior poses special problems. For example, a ship's dining room needs furnishings that will stay in place when the ship rolls. A kindergarten classroom should have small-scale furnishings that create a happy mood and withstand hard wear by children. A bank interior will have a spacious appearance with furnishings designed to create a dignified yet modern atmosphere. On the other hand, a theater lobby might emphasize plush carpets and large chandeliers to express a sense of elegance.

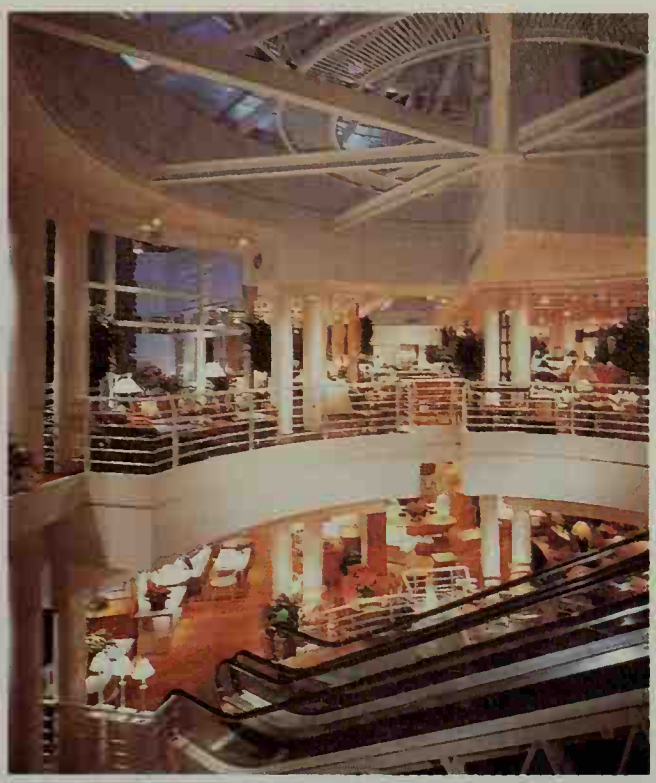
Interior design is closely related to *interior architecture*—that is, the shape, special features, and style built into an indoor area. For example, a bay window, archway, stairway, or fireplace may be part of an area's interior architecture. If some architectural feature does not suit the design plan, a designer may use furnishings, color, or some other item in the plan to conceal that feature or to draw attention from it. On the other hand, the design plan might be used to attract attention to an architectural feature. Designers try to make their design harmonize with the interior architecture. For example, furnishings in a room with stained-glass windows and antique paneling should fit the elegant mood created by the architecture.

Many professional designers describe interior design as the art of creating an *interior environment.* Just as no one outdoor environment is suitable for all animals, no one interior environment is right for all people. Good interior design results in an attractive, comfortable area that satisfies the needs and the desires of its users.

Denise L. Caringer, the critical reviewer of this article, is Executive Interior Design Editor for Better Homes and Gardens *magazine. Ethel Nemetz, who served as a consultant for the illustrations for this article, is President of EN Design Associates.*

Jon Miller, Hedrich Blessing (Mekus Johnson, Inc.)

A modern office features an open arrangement of partitions and furniture. The design maintains a feeling of freedom while providing practical individual work areas.



Steve Hall, Hedrich Blessing

A department store displays merchandise in an open design, allowing customers to move easily from area to area. Conveniently located escalators move customers between floors.

Elements of design

Every interior—whether it is a home, an office, a bank, or an automobile—combines certain basic elements of interior design. The most important elements are *style,* form, color and light, scale, and *pattern and texture.* Each element can be used in various ways to produce a wide variety of effects. In the case of pattern, for example, the ceiling in a room will appear higher with vertically striped wall coverings than with floral print wall coverings.

There is no one right or wrong application of any of the elements of design. The way a person chooses to use each element depends on the interior's purpose, the mood to be created, and the interior architecture. The person must also consider how all the elements combine with one another.

Style. Most people associate style with the types of furnishings and architecture developed during a particular period of history. For example, Louis XIV style recreates the elaborate, formal furnishings found in French palaces during the reign of King Louis XIV (1643-1715). Early American style copies the sturdy, unornamented homes and furniture common in the American Colonies during the 1600's and 1700's. Some people classify interiors decorated in period styles as *traditional* and all other interiors as *contemporary,* or *modern.* See **Furniture.**

Style also has a much broader meaning than that of the furnishings and architecture of a particular period This broader meaning refers to the mood created by the combination of all items in an interior. Many designers believe the interior architecture and the needs of the people using an area should determine its style, or mood. These designers do not try to create interiors that imitate the style of any one period. Instead, they may combine period and contemporary furnishings to fit the mood of an interior. Many designers use the term *eclectic* to describe an interior decorated in a combination of period and contemporary styles.

Form refers to both the shape and the structural materials of an interior itself and of the furnishings within the interior. In good design, the form of the furnishings harmonizes with the form of the interior. For example, an airline terminal designed in free-flowing curves might include built-in curved furniture.

The form of furniture must also suit the furniture's purpose. For example, a chair made of tubular steel and plastic might be a good form for the study area of a modern public library. The chair's simple lines suit the modern interior, and its durable composition will withstand constant use by adults and children. The same chair, however, might be an unsuitable form for home television viewing if it did not provide comfort over a long period.

Color and light together may be used in many ways to produce different effects. Dark-colored walls, for example, may absorb most of the light falling on them, making a room seem dimly lit. However, the same amount of light will appear brighter in a room with pale-colored walls because pale colors reflect light. People feel most relaxed in rooms that have some variation in

Barbara Strauss Cowan ASID

Color helps to establish the general mood of an interior. The designer has created a restful, soothing atmosphere for this master bedroom by combining beige fabrics and furniture with soft lighting. To provide interesting contrasts to this basically monochromatic color scheme, the designer has added bright accents in the picture, flowers, and ceramic vase and dish.

color and light. Uniform light may give an office a businesslike atmosphere, but such light becomes boring for relaxation or dining.

Color can appear to change the size of a room. Walls painted a dark or bright color can make a room seem smaller than it is. Such colors give the illusion that the walls are closer to the room's center than they actually are. On the other hand, pale colors can make a room appear larger and airier because they make the walls seem farther away.

Scale refers to the relationships between the size of an interior, the size of its furnishings, and the size of the people who use the interior. A design for an area is in scale when the sizes of the interior, furnishings, and people are in balance with one another. A design is out of scale when any of these elements appears too large, too small, too heavy, or too light. For example, a tall floor lamp would be out of scale next to a sleek, low sofa.

The scale of an interior and its furnishings has definite psychological effects on people, though responses may differ from person to person. Some people enjoy the coziness of low ceilings, while others feel more comfortable in the airy openness of high ceilings. People may also feel uneasy if the furnishings they use are not in scale. For instance, children might feel uncomfortable in a playroom furnished with adult-sized tables and chairs.

Pattern and texture. *Pattern* refers to the designs in window treatments, draperies, floor coverings, and other items in an interior. *Texture* refers to the surface appearance or feel of the items. Even if people do not touch all items in an area, their eyes interpret the texture of these items.

Pattern and texture are closely related. For example, patterns in some fabrics and floor and wall coverings give the illusion of variation in texture. On the other hand, some textures, such as grained wood, create definite patterns.

Interiors with too little or too great a variety of patterns and textures can affect people psychologically. For example, a room decorated entirely with smooth-textured, white materials may bore people. A room decorated with an unplanned mixture of textured and patterned fabrics can be mentally agitating.

Textures affect color and light distribution. Very

M. J. Kamin ASID

Variations in pattern and color can be provided by both the furnishings and the architecture of an interior. In this sitting room, the geometric pattern of the carpet is reinforced by the rectangular glass tables and windows and the oblong bookcase. The coordinated black, red, and white color scheme further emphasizes the room's bright, modern appearance.

smooth textures may reflect so much light that they create a mirror effect. However, deep, heavy textures absorb and distort light. As a result, a deeply textured white carpet appears to be much darker than a smooth white wall.

Texture and pattern also have a relationship to scale. For example, walls made of large blocks of deeply grooved concrete might appear in scale in a large auditorium, but they might appear out of scale in a small room of a home.

Developing a plan

Before developing a plan for an interior, a designer must consider a number of things. The designer, whether a professional or nonprofessional, must first determine the purpose of the area, the life style of those who will use it, and the budget available.

Many designers begin by listing all the activities an area might be used for so that the final plan will provide the right atmosphere and the necessary facilities for each activity. The main purpose of such a room as a bedroom is obvious. But the room may also have several

less obvious uses. The master bedroom, for example, might also serve as a family office, which needs a desk, desk chair, and lighting for desk work.

Like the purpose of the interior, the life style of those who use it helps determine both the mood and the specific items to be included in the design plan. For example, active children need a play area with a bright mood and with furnishings that withstand rough treatment. Most people who enjoy casual living prefer a simply furnished room to an elaborate, formal one. Individual preferences for colors and materials as well as personal interests in a sport or hobby may also help in creating the design plan.

A budget can help a designer make the best use of the money available for an interior design project. Many people seek ways to cut expenses, which permits them to spend more money on expensive parts of the design. Some people may reuse old furniture, carpets, or other items in their new design. They may also choose to save money by restoring old furniture.

A budget may also be important in making a predesign analysis of the interior architecture. For instance, if a large budget is available for a project, the designer may wish to change the size or shape of an area by removing walls or by adding such features as partitions or built-in cabinets.

All the predesign considerations help establish what professional designers refer to as the *design concept.* The design concept may be the general mood desired for an interior; a design element, such as pattern or texture; or a specific item, such as a favorite piece of furniture or a painting. By selecting each item for the interior to harmonize with the design concept, the designer can create a unified final plan.

Planning on paper. A floor plan drawn to scale helps both professional and nonprofessional designers decide the best way to arrange the furniture in a room. Many designers use a scale of $\frac{1}{4}$ inch to represent 1 foot. The floor plan of a room 12 feet by 16 feet would thus be drawn as 3 inches by 4 inches. The plan should show the location and width of the walls, windows, doors, closets, and other built-in features. It should also show the location of heating and cooling units and of electric outlets.

A careful study of the floor plan helps the designer decide what areas can be used for furniture arrangements and what areas must be left open. For example, areas next to heating or cooling vents would not be suitable places for heavy furniture, which would block the circulation of air into the room. Doorways should be kept clear so people can easily move into and out of a room.

Furniture arrangements can be tested by cutting out pieces of paper in the shapes of the pieces of furniture and then shifting them about on the floor plan. The designer should draw these furniture patterns, called *templates,* to the same scale as the floor plan. Most designers develop two or more room arrangement plans so

Betty Jo Purvis ASID

Kitchen design must be especially functional. The sinks, counter space, drawers, and appliances should be arranged so they can be used conveniently and efficiently. This kitchen is designed to open directly into the home's dining room.

they can compare the effectiveness of each. A person who intends to purchase new furniture can experiment with arranging a great variety of different furniture shapes. A person who plans to reuse old furniture is more limited in shapes but may still experiment with various arrangements. The designer may also try the arrangements suggested by floor coverings. Area rugs, which cover only part of a floor, may lead to different arrangements than wall-to-wall carpet.

A furniture arrangement may help define *traffic patterns*—the paths people follow into, through, and out of a room. If furniture is placed around the edges of a room, people must walk through the center. If furniture is grouped in the center, they must walk around the edges.

A room that is used for more than one activity may have two or more furniture groupings. For example, a family room might have separate groupings for television viewing, game playing, and reading. A child's bedroom may include groupings for sleeping, for study, and for play.

Using color. Color offers one of the easiest and least expensive ways to add interest to an interior. Simply painting the walls a different color may completely alter the mood of a room. The variety of colors available in paints, fabrics, floor and wall coverings, and furnishings is almost unlimited. Many modern paints, fabrics, and other decorating materials can be washed easily, and so almost any color can be practical for any room. The choice of a room's color depends on personal preferences, lighting, interior architecture, and the kinds of activities taking place there.

Color schemes. The combination of different colors or the use of different shades of the same color make up an interior's *color scheme.* Three popular color schemes are based on the relationship of the various colors on the color wheel, a chart that shows a range of colors in the form of a circle (see **Color** [picture: The color circle]). *Related* color schemes combine colors that lie next to each other on the color wheel, such as yellows and oranges or blues and greens. Such colors may blend together to give a soft effect. *Complementary* color schemes combine colors that lie opposite one another on the color wheel. Rooms decorated in combinations of blues and oranges or reds and greens illustrate the bold effect of complementary color schemes. *Monochromatic* color schemes use variations of one color, such as several shades of blue, to create a unified effect. A monochromatic scheme may include *accents* (small areas) of black and white.

Color choices need not be limited to related, complementary, or monochromatic schemes. Any color scheme can be created to suit the taste of those using the room. Some people decorate most of a room with neutral shades—such as light tan, off-white, or white—and then use color in small areas to add interest. Others skillfully combine a number of bright colors. Some people repeat one or more colors throughout their home to provide unity among the rooms. Many people develop a color scheme from the colors in a favorite painting, a favorite piece of furniture, or some other article that will be used in the interior.

Color distribution. The distribution of various colors throughout an interior is just as important to the design plan as the colors themselves. Some colors that seem appealing in small amounts may lose their appeal on a large expanse of wall or on large furnishings, such as a sofa.

Kohler Company

Access for the disabled sometimes figures into the design of an interior. In this bathroom, the bathtub is equipped with a door that allows easy entrance and exit. Other elements of the bathroom, such as the height of the sink and location of light switches, may also require special adjustments.

A person may obtain fabric or paint samples from stores to see how various colors will look in a room. Colors do not appear the same in daylight as they do in artificial light, and so color samples should be tested in the type of light the room has. A person who finds certain bright colors overpowering in bright sunlight may find the same colors appealing when seen in soft artificial light.

Color distribution can emphasize or de-emphasize the interior architecture, the furniture, or other features of an interior. A person who wishes to place more emphasis on the furnishings than on the architecture of a home may choose to paint the walls a neutral shade. Such walls reflect and emphasize the colors used in the furnishings, floor coverings, and accessories. Window treatments that contrast with the color of walls draw attention to the shape of the windows. Window treatments that match the wall coloring help the windows blend into the walls.

Color distribution can visually change the architecture and furnishings of a room. For example, painting

Mary Janice Muldowney ASID

A child's bedroom is designed in a cheerful, colorful style. Bunk beds are the only major piece of furniture in this bedroom. The large amount of open floor space allows the child plenty of room for playing. Toys can be conveniently stored on the upper bunk.

the ceiling of a room a lighter color than that of the walls can make the ceiling seem higher than it is. Painting one wall a lighter tint of a color than that used on the other three walls can add depth to a room. The same effect may be achieved by painting three walls the same color and by painting a mural on the fourth wall. Or a light wood tone can be used on one wall and a darker tone on the others.

To make a large chair seem smaller, a designer can place it next to a wall of the same color. The chair and the wall will appear to blend together.

Choosing patterns and textures. Like colors, patterns and textures can emphasize or de-emphasize the architecture, furnishings, or other features found in a room. For example, window shades covered with a bold pattern may be used to draw attention to a window area. A wide variety of fabrics and floor and wall coverings offer many other possibilities for emphasizing or de-emphasizing various features of an interior. The natural textures of some building materials, such as brick, may also be used to emphasize an architectural feature, such as a wall or fireplace. Wood, slate, and marble floors can provide patterns and textures that draw attention to the floors.

The amount and kind of use an area or furnishing receives can help a person in selecting patterns and textures. In general, patterned materials show dirt and wear less readily than do solid colors, and slightly textured materials appear clean longer than do smooth, glossy surfaces.

The composition of various materials also affects wearability and maintenance. Some materials have similar patterns or textures but differ greatly in wearability and cost. For these reasons, it is helpful to know something about the materials used in (1) fabrics, (2) floor coverings, and (3) wall coverings.

Fabrics. Major fabrics used in interior design include those made from such natural fibers as wool, cotton, and linen and those made from such synthetic fibers as acrylic, polyester, and glass fiber. Wool can be woven into an extremely strong fabric with either a rough or a smooth texture. It has long been popular for upholstery fabrics because it molds easily to almost any shape of furniture. Fabrics made of cotton and linen cannot withstand the heavy wear received by upholstery. But they make long-wearing, washable curtains, tablecloths, and bedspreads.

Acrylics and polyesters have the same durability as wool but are less expensive. Acrylics look and feel like wool, and upholstery fabrics made from acrylic are easy to clean. Polyester and olefin fibers give materials a durable press finish. They are often combined with other fibers, such as cotton, to make material for curtains and bedspreads. Fabrics made from glass fiber are fire-resistant, inexpensive, and easy to keep clean. Fiberglass fabrics come in a wide range of patterns and in textures that resemble cotton, linen, or silk. However, the fiber's itchy feel limits its use to draperies.

Floor coverings. If floor coverings are to be used, a person must choose between carpets, area rugs, or hard coverings, known as *resilient floors.* Carpets help unify the entire room. Area rugs may be used to unify separate furniture groupings. Both carpets and rugs help create a warm, cozy mood. They deaden sound and provide safety from falls and breakage. Carpets and rugs come in many colors, patterns, and textures. They range from elegant, plush *piles* to low, level-loop commercial carpet. Some types have combinations of textures and loops that create interesting surfaces.

Carpets and rugs are made of such natural fibers as wool and such artificial fibers as nylon, polyester, and *Olefin.* Nylon is used most often, since it is economical,

durable, and stain-resistant. Wool, the traditional carpet and rug fiber, has been used since ancient times. Wool is still used today, but because it is more expensive, it is used less often than nylon. Because they are stain-resistant and resilient, wool carpets tend to look good during their whole *wear life*.

Resilient floors offer the advantages of easy cleaning and simple, inexpensive installation in tile or sheet form. Resilient floor materials include vinyl, ceramic tile, and cork. Of these floors, vinyl is the most durable and comes in the greatest range of colors and designs. It comes in sheets and individual tiles. Cork tile is popular for dens and libraries because it absorbs noise. But it comes only in shades of brown and is easily indented by furniture and heels. Some cork tile has a protective coating of glossy vinyl to help prevent indents.

Wall coverings are available in a great variety of patterns and textures. Many people refer to wall coverings as *wallpaper*. Wall coverings made of such materials as China grass cloth, linen, or burlap provide good sound absorption. Some of these products are coated with plastic, which makes them even easier to clean than painted plaster walls. Plastic-coated or vinyl wall coverings are especially suited to kitchens and bathrooms because they withstand steam better than painted surfaces. These types of coverings also resist grease.

Some people decorate certain rooms with leather, metallic, or plastic wall coverings, available on bolts in some fabric stores. Vinyl-coated fabrics, which are completely washable, are well-suited to busy areas, such as a bathroom or child's playroom. Cork wall coverings provide an attractive, casual appearance. They also absorb sound well.

Some people use carpet as a wall covering. It absorbs sound and can be easily cleaned with a vacuum cleaner attachment.

Selecting accessories. *Accessories* are the small, movable objects and decorations that complete an interior design. Some accessories, such as paintings, sculptures, or other works of art, are wholly decorative. Others, such as ashtrays and clocks, are useful as well as decorative. Accessories may provide accents of color and add interest to a room, but they should harmonize with the rest of the room in scale, form, and mood.

Lamps are usually considered accessories, but they are also a necessity. Although some rooms in a home may have a built-in lighting system, lamps may still be needed for such pastimes as reading or sewing. Lamps may also serve to highlight an object or area or to help set a general mood. A person should carefully choose between *incandescent* and *fluorescent* lights because color schemes appear different under each type of illumination. Incandescent light is a bright golden light, while fluorescent light provides less-glaring light. Many businesses use fluorescent lights to illuminate their offices, and there are small fluorescent tubes that fit into table lamps and track lights for the home. Today, fluorescents can provide cool light, warm light, or full-spectrum light that imitates the light of the sun.

In a home, accessories add the owner's personality to the interior design. For instance, many people display their collections of antiques, china, glassware, rocks and shells, or other objects. In some cases, a room's entire design may be built around collections, artworks, or other accessories that have special meaning to the owner.

Ann Milligan Gray ASID

A combination of patterns can achieve a striking design effect. In this study, the horizontal ceiling light fixtures contrast with the vertical drapes over the windows. The monochromatic drapes and fixtures further contrast with the decorative designs of the carpet and the sofa covering.

Careers in interior design

The professional designer has the job of creating interiors that suit both the needs and the desires of the client. For example, a designer and client may spend several months planning the decoration of a large hotel. The need to establish the special uses of each area and determine the budget. The designer must also take the client's preferences into account when developing a design plan. The designer may then spend several more months creating alternate design plans, purchasing the materials necessary for the design, and transforming the final plan into reality.

Training. The majority of elementary and high schools offer little or no training in interior design. Most schools that do offer courses include them in the home economics program. An elementary or high school student desiring a career in interior design should study a broad range of subjects, including the arts, philosophy, and psychology. Courses in the arts can help develop creativity and artistic appreciation. Courses in philosophy and psychology can help the student understand why people think and act as they do.

Professional design schools offer three- and four-year courses leading to a diploma in interior design. Most design schools require a high school education. In addition to design schools, the art, architecture, and home economics departments of many universities and colleges offer interior design programs leading to bachelor's and master's degrees. In both design schools and universities, these programs teach students how to create residential, commercial, and institutional interiors. Most programs include courses in color, design, drafting, drawing, history, and psychology.

Several professional design organizations aid both students and established professional designers. The largest group, the American Society of Interior Designers (ASID), has about 33,000 members. The International Interior Design Association (IIDA) has about 8,000 members, and the Interior Design Educators Council (IDEC) has about 500. All of these groups provide special student education programs as well as continuing education programs for professionals. The organizations also work to establish and enforce codes of professional conduct. In addition, these organizations work to promote better public understanding of the interior design profession.

The ASID and IDEC together sponsor the Foundation for Interior Design Research (FIDER). FIDER evaluates the courses, facilities, and faculties at interior design

Steinkamp/Ballogg from Lettuce Entertain You Enterprises, Inc.

A theme restaurant that features Italian-style food has an interior influenced by rustic Italian furnishings and architecture. Wood dominates the room in the roof beams, the walls and doorways, the bar, and the pillars. The designer further expressed a sense of informality and intimacy through the small tables with their floral tableclothes and the simple wine racks at the right.

M. J. Kamin ASID

A public area in a home for senior citizens is designed in pleasing earth tones. The heavily patterned wallpaper and carpet contrast with the simple geometric inlay design of the elevator door on the left and the glass double doors on the right.

Cheri Lynn Friedman ASID

An executive's office achieves a strong sense of authority and dignity through the emphasis on dark natural woods and leather upholstery. The designer added the light-colored carpet and visitors chairs to keep the room from appearing too heavy.

schools. The foundation began accrediting schools of design in 1971.

Some states require interior designers to have a license to practice. These states base their licensing requirements on standards established by the ASID and other organizations.

Opportunities. More and more individuals, businesses, and industries depend on professional designers to create their interiors. Many interior designers concentrate on nonresidential work. Among ASID members in the United States, nonresidential work accounts for about 50 percent of all interior design commissions. Homes and apartment interiors make up the remaining commissions.

A professional designer may set up a private practice or join a firm of interior designers. Many architectural offices, government agencies, and real estate builders and developers have interior design staffs. Some department and furniture stores hire interior designers to assist customers and to help sell merchandise. A number of designers specialize in certain areas of the profession, such as administration, drawing, or working directly with clients.

The fees charged by professional designers vary. Some interior designers charge a percentage of the total cost of the materials for a project. Others base their fee on the amount of professional time spent on a project. Still other designers establish a flat fee at the beginning of a project, based on the range of the services involved. Further information on interior design can be obtained from the ASID headquarters in Washington, D.C.

Critically reviewed by Denise L. Caringer

Study aids

Related articles in *World Book* include:

Architecture
Color
Flooring
Furniture
House
Lighting
Linoleum
Paint
Painting (Decoration)
Rugs and carpets
Tile
Wallpaper

Outline

I. Elements of design
- A. Style
- B. Form
- C. Color and light
- D. Scale
- E. Pattern and texture

II. Developing a plan
- A. Planning on paper
- B. Using color
- C. Choosing patterns and textures
- D. Selecting accessories

III. Careers in interior design
- A. Training
- B. Opportunities

Questions

Why is wool a popular upholstery fabric?
How does texture affect the appearance of a color?
What are examples of a complementary color scheme?
What kinds of things should be shown on the floor plan of a room?
What does *scale* refer to in interior design?
How can color be used to emphasize a certain architectural feature?
What are some wall covering materials with good sound absorption qualities?
How can different uses of color appear to change the size of a room?
Where can a person receive training for a career in interior design?
What are some things a designer should consider before developing a plan for an interior?

Additional resources

Banham, Joanna, ed. *Encyclopedia of Interior Design.* 2 vols. Fitzroy Dearborn, 1997.

House Beautiful editors, and Garey, Carol. *House Beautiful Decorating Style.* Hearst, 1992.

Pile, John F. *Interior Design.* 2nd ed. Abrams, 1995.

Wissinger, Joanna. *The Interior Design Handbook.* Henry Holt, 1995.

Interjection, *IHN tuhr JEHK shuhn,* is a word used in a sentence as an independent element, grammatically unrelated to the other words. The term comes from a Latin word meaning *thrown in between.* The interjection has no identifiable features of form, but it may be described by its use.

Interjections generally express some kind of emotion, such as pain, sorrow, anger, or relief. Many are sound words, such as *ouch, whew,* and *oh.* Most swearwords are interjections, as are the polite forms related to swearwords, such as *darn, gosh,* and *heck.* But in the expression "That's a darned shame," *darned* is a modifier, not an interjection.

Interjections serve as fillers and attention-getters. *Oh, well,* and *why* are basically filler words in such expressions as "Oh, I don't think so," "Well, we might try," and "Why, that's too bad." Expressions like *say, look,* and *hey there* are either signals to listen or forms of address, as in "Say, I have an idea" or "Hey there, what's going on?"

In writing, exclamation marks sometimes follow interjections. More often, a comma separates an interjection from the words that follow. Susan M. Gass

Interleukin, *IHN tuhr LOO kihn,* is the name of a group of proteins that serve as messengers among the cells of the body's immune system. Interleukins are produced chiefly by white blood cells during the disease-fighting process known as an *immune response.* Individual interleukins affect only those cells that have a *receptor* for them. A receptor is a protein molecule on the surface of a cell. The interleukin binds to the receptor, signaling the cell to activate its immune function and to multiply. Coordination of the cells in the immune system by interleukins enables the body to neutralize viruses, bacteria, and other foreign substances.

There are at least 15 different interleukins. They are named numerically, starting with interleukin 1 (IL-1). Each has a distinct function in coordinating the immune response. For example, IL-1 from white blood cells called *phagocytes* helps activate other white blood cells called *T cells.* The T cells produce IL-2, which stimulates the production of more T cells to fight infection.

The first interleukins were discovered in the 1970's. Current techniques in genetic engineering enable scientists to produce vast quantities of interleukins in the laboratory. Researchers are investigating many applications of interleukins, such as treatment of immune deficiency diseases and cancer, and preventing rejection of transplanted organs. Neal R. Pellis

See also **Immune system.**

Interlingua, *ihn tuhr LIHNG gwuh,* is an international language developed for scientific and medical writing. Its purpose is to help scientists of many lands communicate with one another. Interlingua is based on root words and grammatical forms that are common to the leading European languages. Most people familiar with one of these languages can understand Interlingua without training.

For a word to be included in Interlingua, a form of that word must be found in a majority of the languages on which Interlingua is based. These forms must have at least one common meaning. To be part of Interlingua's grammar, the grammatical feature must be found in all the languages. If the feature is absent from even one language, it is not used in Interlingua.

The first Interlingua dictionary appeared in 1951. Further information can be obtained from the Interlingua Institute, 496A Hudson Street, New York, NY 10014.

Critically reviewed by the Interlingua Institute

Intermezzo, *ihn tuhr MEHT soh,* is a type of musical composition that has had many functions during its history. The plural is *intermezzos* or *intermezzi.* Intermezzos originated during the 1500's as an instrumental or vocal piece performed between the acts of a play. These intermezzos became a forerunner of opera. In Italy in the early 1700's, an intermezzo was a short comic work performed between the acts of a serious opera. During the 1600's in Italy and the 1600's and 1700's in France, opera companies often used ballets as intermezzos between the acts of operas.

During the 1800's, an intermezzo came to mean a short orchestral piece inserted into an opera. Pietro Mascagni's *Cavalleria rusticana* (1890) is an example of an opera with an intermezzo. The term also refers to a brief movement in a symphony, concerto, or sonata. Felix Mendelssohn included an intermezzo in his incidental music (1843) for William Shakespeare's comedy *A Midsummer Night's Dream.* Separate compositions for solo piano were also known as intermezzos. During the 1800's, Robert Schumann and Johannes Brahms composed many such intermezzos.

Some composers of the 1900's have added intermezzos as light interludes in larger works. One example is Béla Bartók's *Concerto for Orchestra* (1944).

R. M. Longyear

See also **Opera** (Opera seria and opera buffa); **Drama** (Intermezzi and operas).

Internal-combustion engine is a device in which the burning of a mixture of fuel and air produces mechanical energy to perform useful work. The *combustion* (burning) of the mixture creates hot gases that push against turbine blades or against one or more pistons or rotors. Each blade, piston, or rotor is connected to an *output shaft.* This shaft rotates, transferring the mechanical energy to another location to perform useful work. Internal-combustion engines include gas-turbine, diesel, and both piston-type and rotary gasoline engines. In *external-combustion engines,* including steam engines, the hot gases transfer heat energy to another fluid. This fluid, in turn, pushes against turbine blades or other moving parts. William H. Haverdink

See also **Diesel engine; Gasoline engine; Rotary engine; Steam engine.**

Internal medicine is a branch of medicine that deals with disorders of the internal body structures of adults. Doctors who practice internal medicine are called *internists.* A patient goes to an internist with a specific problem or for a checkup. In either case, the internist does a complete evaluation of the patient.

If the patient has a problem, the internist begins the evaluation by asking the patient questions relating to the problem and to all the organ systems. The internist also asks questions about the patient's background, such as past medical problems, illnesses in the patient's family, and the patient's life style. Next, the internist gives the patient a thorough physical examination. Blood tests are conducted and X rays and an electrocardiogram may be taken. The internist also may order specialized tests, such as *ultrasound, radionuclide scan,* and *computer-*

ized axial tomography (CAT scan) (see Computed tomography; Radiochemistry; Ultrasound; X rays [In medicine]).

The internist interprets this information and makes a final evaluation and a decision on treatment. The internist may prescribe medications and also may decide that further procedures, such as surgery, are needed.

Many internists concentrate in a particular area of internal medicine. For example, they may specialize in cancer or infectious diseases, or in specific organ systems, such as the heart and blood vessels, the lungs, or the digestive system. Elizabeth Mary Lutas

Internal revenue is the income a government derives from sources within the country, in contrast to income from export and import duties. It includes income, payroll, estate, gift, sales, and *excise* taxes. Excise taxes are levied on the manufacture, sale, or use of one or a few goods or services.

In the United States, internal revenue amounts to about 95 percent of the total revenue of the federal government. The U.S. Constitution does not indicate how the various kinds of taxes are to be divided between the federal and state governments. But customarily, land and other property taxes and sales and excise taxes have gone chiefly to the states. The federal government relies mainly on income and payroll taxes.

The Internal Revenue Service, an agency of the Department of the Treasury, administers and enforces U.S. internal revenue laws. The Internal Revenue Service checks tax returns, collects tax payments, and issues refunds.

History. Early in United States history, internal revenue accounted for only a small part of the total government revenue. The federal government depended mainly on customs duties as a source of revenue. The proportion between customs duties and internal revenue remained roughly the same until after the American Civil War ended in 1865. Since that time, customs duties have become much less important.

About the time of the Civil War, the government began to seek a new tax with which to increase its revenue. An income tax was levied in 1862 and was continued for about 10 years. A second income tax was levied in 1894, but the Supreme Court declared it unconstitutional. In 1913, the 16th Amendment to the U.S. Constitution allowed Congress to levy income taxes without the former constitutional restrictions.

The first excise tax on distilled spirits was levied in 1791. The tax caused the unsuccessful Whiskey Rebellion of 1794, which was led by farmers in western Pennsylvania. Taxes on alcoholic beverages brought little revenue until the repeal of prohibition in 1933. They now make up about 1 percent of all internal revenue.

Today, almost all federal income is derived from internal revenue. Over 90 percent of this revenue comes from income and payroll taxes. Much of the rest comes from excise taxes levied on alcohol, gasoline, and tobacco and from estate and gift taxes.

In Canada, federal revenue comes mainly from income taxes. The federal government also levies a sales tax and excise taxes on such items as alcohol, gasoline, and tobacco. Provincial governments levy income taxes, property taxes, sales taxes, and excise taxes.

Joseph J. Cordes

Related articles in *World Book* include:

Excise
Income tax
Inland revenue
Internal Revenue Service
Stamp
Taxation
Whiskey Rebellion

Internal Revenue Service is the agency of the United States Department of the Treasury that collects income taxes. The agency, often called the IRS, also enforces tax laws, advises taxpayers, and collects estate, excise, gift, and other taxes. The money the IRS collects is called *internal revenue* because it comes from sources within the country. Tax money pays for most U.S. government activities, including national defense.

The IRS administers a tax system based on voluntary cooperation. After the end of each year, the taxpayer fills out a form, called a *tax return,* stating income and the amount of tax owed for the year. The taxpayer then sends the form to the IRS. Most people have already paid much or all of what they owe through the *pay-as-you-go* plan. Under this system, employers collect a *withholding tax* from each paycheck and send the tax to the IRS. If a taxpayer owes still more tax, the additional money must be sent to the IRS by April 15. If too much tax has been paid, the agency issues a refund.

The IRS handles many millions of tax returns annually. Computers check the returns for mistakes in arithmetic and other errors. On some returns, the IRS performs a detailed examination called an *audit.* An IRS agent may ask the taxpayer to furnish proof of the *deductions* and *exemptions* claimed on the tax return (see Income tax). The agent then may decide the person owes additional taxes. If the taxpayer disagrees, an appeal can be made to various IRS officials. If an agreement is not reached, the taxpayer can then appeal to the United States Tax Court or, in some cases, to other federal courts.

The government set up the Office of Internal Revenue in 1862 to help pay the cost of the American Civil War. The federal income tax system began in 1913, and the pay-as-you-go plan in 1943. In 1998, Congress passed legislation designed to help protect the rights of taxpayers. The law created an independent nine-member board to oversee IRS activities. The board consists of the treasury secretary, the commissioner of the IRS, and seven individuals appointed by the president. IRS headquarters are in Washington, D.C. Harvey Glickman

See also Internal revenue; Tax Court, U.S.

International Air Transport Association (IATA) is an organization of the world's scheduled international airlines. The IATA promotes safe, regular, and economical air transport. It also fosters air commerce and studies the problems connected with it. Any airline licensed to provide scheduled air service by a government eligible for membership in the International Civil Aviation Organization (ICAO) may join the IATA (see International Civil Aviation Organization). The IATA was founded in 1945. Its headquarters are in Montreal, Canada.

Critically reviewed by the International Air Transport Association

International Atomic Energy Agency (IAEA) is an organization that promotes safe and peaceful uses of nuclear energy throughout the world. It also works to ensure that nuclear materials intended for peaceful activities are not used for military purposes. About 110 nations belong to the IAEA.

The IAEA advises nations, especially developing na-

tions, how to use nuclear materials in agriculture, industry, medicine, and other nonmilitary areas. It also develops safety standards for nuclear power plants and advises nations how to build such facilities. In addition, the IAEA organizes technical meetings, publishes scientific reports, and operates three research laboratories.

An important duty of the IAEA is to verify that countries abide by the Treaty on the Nonproliferation of Nuclear Weapons, a United Nations treaty that forbids the spread of nuclear weapons. Each year, IAEA officials inspect hundreds of nuclear facilities in more than 50 countries to try to account for all the nuclear materials of the treaty signers. The IAEA also makes sure that countries abide by other treaties, including agreements that establish nuclear-weapon-free zones in Latin America and the South Pacific Ocean.

The United Nations founded the IAEA in 1957. IAEA headquarters are in Vienna, Austria.

Critically reviewed by the International Atomic Energy Agency

See also Nuclear Nonproliferation Treaty; United Nations (Peaceful uses of nuclear energy).

International Bank for Reconstruction and Development. See World Bank.

International Bureau of Weights and Measures is an international organization that standardizes units of measure. Forty-seven countries belong to the bureau, including the United States and Canada. The bureau establishes standards for metric measurements and ensures worldwide unification of physical measurements. The International Bureau of Weights and Measures was founded in Paris in 1875. Headquarters are at Sèvres, near Paris.

Critically reviewed by the International Bureau of Weights and Measures

See also Metric system (Evolution of the metric system).

International Business Machines Corporation (IBM) is the world's largest manufacturer of information systems and equipment. IBM produces computers that range in size from large mainframes to portable laptops. The company also offers computer services that help customers develop and operate information systems. In addition, IBM supplies such hardware devices as disk drives and printers. It also develops software products for both business applications and consumer use.

International Business Machines Corporation grew out of an earlier firm, the Computing-Tabulating-Recording Company. It adopted its present name in 1924. From the 1960's to the early 1980's, IBM dominated the office equipment and information technology industries. The company's mainframe computers provided the cornerstone for its success.

In the mid-1980's, IBM's market share declined as powerful personal computers, which were smaller and cheaper than mainframes, became increasingly popular. Nevertheless, IBM remained the world's largest computer manufacturer. In 1995, the company acquired Lotus Development Corporation, a leading software developer. In 1997, IBM and World Book, Inc., released an electronic reference work called *The World Book Multimedia Encyclopedia.* The multimedia product provided animations, maps, pictures, videos, and audio in addition to the text of *The World Book Encyclopedia* on CD-ROM (*C*ompact *D*isc *R*ead-*O*nly *M*emory). IBM headquarters are in Armonk, New York. John W. Verity

See also Manufacturing (table); Watson, Thomas J.

International Civil Aviation Organization (ICAO) is a specialized agency related to the United Nations that promotes the safe and orderly growth of civil aviation. It sets international standards in such fields as air navigational facilities, air operations, airports, airworthiness of aircraft, and communications. The ICAO is also concerned with the efficiency and economics of air transport, and it encourages flight safety. It also works to establish international laws that deal with such crimes as airplane hijacking and sabotage. The ICAO helps developing countries build and upgrade airports as well.

Over 180 nations are ICAO members. The agency was founded in 1944. Headquarters are in Montreal, Canada.

Critically reviewed by the International Civil Aviation Organization

International Confederation of Free Trade Unions (ICFTU) is an organization that promotes working people's interests. The ICFTU's goals include the improvement of working and living conditions throughout the world, the advancement of free trade union organizations, and the establishment of educational programs and information services. The ICFTU opposes totalitarian governments and the trade unions imposed on workers by such governments. The organization was founded in London in 1949 by representatives of trade unions in 55 nations. Today, it has affiliated trade union organizations in about 100 countries and territories worldwide. Headquarters are in Brussels, Belgium.

Critically reviewed by the International Confederation of Free Trade Unions

International Council of Scientific Unions (ICSU) coordinates the activities of 20 international unions in the fields of the natural sciences. It has helped to establish some international unions, and to define the borderline areas that might be studied by more than one union, such as oceanic research. It organized the scientific work for the International Geophysical Year, the International Years of the Quiet Sun, and the International Biological Program. The ICSU, with the World Meteorological Organization (WMO), also developed the Global Atmospheric Research Program, the World Climate Research Program, and the International Geosphere-Biosphere Program. Delegates from national scientific organizations and international unions meet every two years. The ICSU is supported by dues from member organizations, grants from private foundations, and grants from UNESCO (United Nations Educational, Scientific and Cultural Organization). The ICSU was founded in Brussels, Belgium, in 1919 as the International Research Council, and changed its name in 1931. Headquarters are in Paris.

Critically reviewed by the International Council of Scientific Unions

International Court of Justice, often called the *World Court,* is a judicial agency of the United Nations. It provides a peaceful means of settling international legal disputes. It handles only cases brought by nations or certain international organizations. Its decisions are based on principles of international law and cannot be appealed. The court hears relatively few cases. But many disputes between governments are settled in other international tribunals and in national tribunals on the basis of international law.

No nation has to appear before the court unless it wishes to do so. However, more than 40 nations have

pledged themselves to accept the court's jurisdiction to a greater or lesser extent. The United States is one of the nations that has agreed to submit international disputes to the court. But the Connally Amendment limits U.S. participation to cases that the federal government decides do not lie "within the domestic jurisdiction" of the United States. If one nation refuses to accept the court's decision, the court cannot take direct action. A country's national interest usually governs the country's acceptance of the court's jurisdiction in a given case. However, nations do not submit cases to the court unless they are prepared to accept its decisions.

The General Assembly and the Security Council elect the 15 members of the court. The judges are chosen without regard to nationality. They serve for nine years, and may be reelected. The court elects its own president, vice president, and registrar. It has headquarters at The Hague, in the Netherlands.

The decisions of the court are based on a majority vote of the judges present. In case of a tie, the president casts the tie-breaking vote. In giving a decision, the court must state its reasons for its action. Any judge may also deliver a separate opinion.

One of the first attempts to set up an international court was the Permanent Court of Arbitration. This court developed from the Hague Peace Conference of 1899. After World War I, the Council of the League of Nations, assisted by a group of judges, made the first plans for the Permanent Court of International Justice. In December 1920, the League of Nations set up the court. The Charter of the United Nations, which was adopted in 1945, organized the International Court of Justice to replace the Permanent Court of International Justice.

Robert J. Pranger

See also **Hague, The; International law; United Nations** (The International Court of Justice).

International Criminal Police Organization. See **Interpol.**

International Date Line is an imaginary line which marks the spot on the earth's surface where each new calendar day begins. The date just to the west of the International Date Line is one day later than the date just to the east of the line.

The International Date Line follows the 180th meridian for most of its distance. The 180th meridian is exactly halfway around the world from Greenwich, a borough of London, England. Another imaginary line, called the *prime meridian* or *Greenwich meridian,* marks 0° of longitude at Greenwich. See **Greenwich meridian.**

The sun travels over 15° of the earth's surface each hour. For each 15° east of Greenwich, the time is advanced one hour. For each 15° west of Greenwich, the time is set back one hour. At longitude 180° East, the time is 12 hours more advanced than Greenwich time. At longitude 180° West, the time is 12 hours behind Greenwich time. When it is noon Saturday in Greenwich, Saturday is just beginning on the eastern side of the International Date Line, and just ending on the western side of the line. As a result, there is a 24-hour time difference between the two sides of the 180th meridian.

A new date first begins on the western side of the date line. As the earth rotates on its axis, this new date sweeps westward around the earth. The date covers the entire earth in 24 hours. January 1 occurs first just to the west of the date line. As a result, people in New Zealand, on the western side of the date line, start celebrating New Year's Day 22 hours ahead of the people in Hawaii, on the eastern side of the date line.

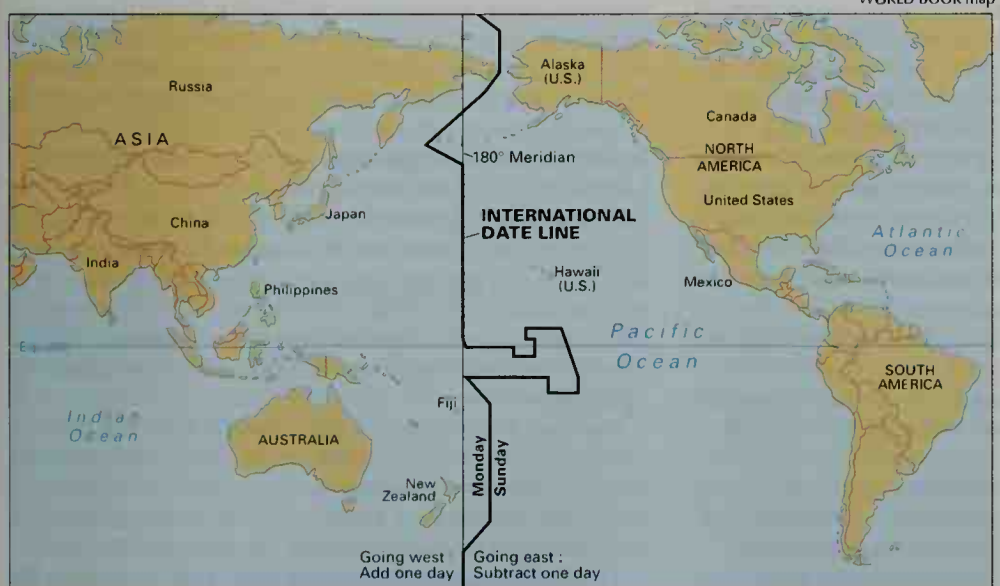
The location of the date line was established through general practice of the larger nations of the world. The date line varies from the 180th meridian in some places in order to avoid differences in date within countries or between islands. For example, the northeastern corner of Siberia extends nearly 10° east of the 180th meridian. If the date line followed the meridian exactly, this little corner of Siberia would have a different date from the rest of Asia. So the date line was moved to run east of Siberia. Part of the Aleutian Islands extends west of the 180th meridian. However, the date line has been curved so that all the Aleutians remain east of it. The date line jogs again at the Fiji Islands to keep all the islands on one side of the line.

Donald B. Sullivan

International Development Association (IDA). See **World Bank.**

International Energy Agency (IEA) is an organization of over 20 nations that are large oil importers. It op-

WORLD BOOK map



The International Date Line runs down the middle of the Pacific Ocean. It follows the 180th meridian most of the way, but zigzags in several places to avoid having two different calendar dates on the same day in a country.

erates as an independent agency within the Organization for Economic Cooperation and Development (OECD). IEA members work together to lessen their dependence on imported oil by promoting energy conservation and the development of alternative energy sources.

The United States, Canada, and several other members of the OECD established the IEA in 1974, following the Arab oil embargo of 1973. Several Arab countries had reduced their oil shipments to many Western nations, causing widespread energy shortages.

The IEA works to promote cooperation among its members and has established a system for sharing oil among member nations during shortages. The agency gathers statistics on the international oil market and uses them to predict future needs. It also works to promote cooperation between oil-producing and oil-consuming countries. Its headquarters are in Paris.

Critically reviewed by the International Energy Agency

International Finance Corporation (IFC) is an investment corporation owned and financed by about 125 countries. The IFC promotes the growth of productive private enterprise in less developed member countries. The corporation invests in private enterprises in such countries without government guarantee. Its investments form part of a larger amount of capital put up by private local or foreign investors. The IFC also invests in projects financed jointly by the government and private investors.

The IFC provides financing by investing in the enterprise's capital stock, by granting loans, or by combinations of the two. It also underwrites issues of corporate securities, provides financial and technical assistance to private development banks, and seeks the investment of private capital to supplement its own.

The IFC was founded in 1956. It is a specialized agency of the United Nations (UN). It is affiliated with the World Bank. Only World Bank members can belong to the IFC. The headquarters of the IFC are located in Washington, D.C.

Critically reviewed by the International Finance Corporation

See also World Bank.

International Fund for Agricultural Development (IFAD) is a specialized agency of the United Nations (UN). IFAD provides financial assistance for agricultural and rural development in poor countries. Nations must be IFAD members to receive aid from the agency. Most countries that belong to the UN, including many developed nations, are members of IFAD.

IFAD finances projects designed to introduce, expand, and improve food production systems in developing countries. It also works to strengthen such nations' agricultural policies and institutions. In addition, it tries to improve the nutritional level and living conditions of the poorest people in developing countries.

IFAD was established in 1977. Its headquarters are in Rome.

Critically reviewed by the International Fund for Agricultural Development

International Geophysical Year (IGY). See Antarctica (Recent activities).

International Joint Commission settles questions about the use of boundary waters between Canada and the United States for water power, navigation, sanitation, irrigation, recreation, and scenic beauty. It also deals with questions arising between the two countries along their common frontier. Since 1972, the commission has also coordinated efforts to reduce pollution of the Great Lakes.

The commission has three members appointed by the president of the United States and three appointed by the Canadian government. It was established by the Boundary Waters Treaty of 1909. The commission has a U.S. office in Washington, D.C.; and Canadian offices in Ottawa and Windsor, Ontario.

Critically reviewed by the International Joint Commission

International Labour Organization (ILO) is a specialized agency of the United Nations (UN) that promotes the welfare of workers. About 150 countries belong to the ILO. In 1969, the organization received the Nobel Peace Prize for its work.

The chief policymaking body of the ILO is called the International Labour Conference. This conference meets yearly and establishes international labor standards covering such matters as child labor, job discrimination, and worker safety. Each member country sends four delegates, two from government and one each from labor and management. The delegates speak and vote independently.

Between conferences, the ILO is supervised by its Governing Body, which consists of 28 government representatives, 14 labor delegates, and 14 management delegates. The permanent staff of the ILO is called the International Labour Office. The staff includes administrative and clerical employees and technical experts. The International Labour Office conducts research, publishes labor information, and provides technical assistance to developing nations. ILO headquarters are in Geneva, Switzerland.

The ILO was established in 1919 as an independent agency of the League of Nations, a world organization that worked to maintain peace. The ILO became part of the UN after the League was dissolved in 1946.

During the 1970's, Arab members of the ILO forced a number of debates that many people considered anti-Israeli and unrelated to the work of the organization. In addition, labor and management delegates from the United States became increasingly concerned that all delegates from Communist countries were actually government representatives. In 1977, after giving the required two years' notice, the United States withdrew from the ILO. The United States rejoined in 1980, saying that ILO officials had returned the organization to its original purposes. James G. Scoville

International language. See Universal language; Language (Universal languages).

International law is the body of rules and general principles that nations are expected to observe in their relations with one another. Some international laws result from years of custom. Others originate in general principles of law recognized by civilized nations. Still others have been agreed to in treaties or determined by judicial decisions.

Many of the customs of international relations have existed for hundreds of years. For example, the ancient Greeks protected foreign ambassadors from mistreatment, even in wartime. For about 2,000 years, nations have given ambassadors similar protection.

Treaties or contracts between countries have been in

use for thousands of years. Such treaties as the one that established the Pan American Union may be signed by many nations. Or they may be signed by only two or three nations, as in the case of trade treaties the United States has signed with other countries.

Kinds of international law

The rules of international law are generally divided into laws of peace, of war, and of neutrality. Peace is considered the normal relationship between nations.

The laws of peace define the rights and duties of nations at peace with one another. Each country has a right to existence, legal equality, jurisdiction over its territory, ownership of property, and diplomatic relations with other countries. Many of the laws of peace deal with recognizing countries as members of the family of nations and recognizing new governments in old nations. Most governments are recognized *de jure*—that is, as rightful governments. Under unsettled conditions, a government may be recognized *de facto*—that is, as actually controlling the country, whether or not by right. Rules dealing with territory include the rights and duties of aliens, the right of passage through territorial waters, and the extradition of criminals.

The laws of war. War is still recognized under traditional international law. Warring states are called *belligerents.* The laws of war provide definite restrictions on methods of warfare. For example, undefended towns, called *open cities,* must not be bombarded. Private property must not be seized by invaders without compensation. Surrendering soldiers may not be killed or assaulted and must be treated as prisoners of war.

All the laws of war have been violated repeatedly. In wartime, nations fight for their existence, and it is not always possible to get them to follow rules. Each nation does its best to destroy its enemy, and it uses the most effective weapons it can find.

Even in war, however, many international rules are observed. During World War II (1939-1945), many of the belligerent nations followed the international rules for the treatment of prisoners of war. Millions of former prisoners of war are alive today because these rules were followed more often than they were broken.

The laws of neutrality. Under international law, belligerents are forbidden to move troops across neutral territory. Neutral waters and ports must not be used for naval operations. Belligerent warships entering neutral ports must leave within 24 hours or be interned.

In the 1800's and 1900's, neutral nations claimed many rights for their ships on the high seas. But laws about neutrals, like laws about war, are often broken. Neutral countries have been invaded in many wars, and neutral rights on the high seas are often ignored.

Enforcement of international law

After a legislative body passes a law for a nation or a state, police enforce the laws, and people who break them are tried in courts. However, there is no international legislature to pass rules that all nations are required to observe. Neither is there an international police force to make countries obey international law. As a result, it is often difficult to enforce international law.

Consent of nations. International laws are often classified according to how many nations accept them. Some rules are accepted by all nations as part of international law. These rules cover such items as the sanctity of treaties, foreign ambassadors' safety, and each nation's jurisdiction over the airspace above its territory. Other rules are accepted by the majority of countries, especially the most powerful ones. One law of this type is the rule that each nation has jurisdiction over its *territorial waters,* a water area typically claimed to extend 12 nautical miles (22 kilometers) from its shores. Many nations follow this rule, but some do not. Ecuador and Peru, for example, claim a limit of 200 nautical miles (370 kilometers). International law also includes agreements, such as trade treaties, between two or several nations.

Violations. Japan violated international law in 1941 by attacking Pearl Harbor without first declaring war. Germany broke international law during World War II when the German government killed millions of European Jews and forced slave laborers from other European nations to work in German war factories. The Soviet Union violated international law by refusing to repatriate many prisoners of war long after the end of World War II.

Reports were given to the United Nations (UN) about the cruel treatment of many UN prisoners of war by the Chinese Communists and North Koreans in the Korean War (1950-1953). Violations occurred in the Nigerian civil war (1967-1970), the Pakistani civil war (1971), and the Vietnam War (1957-1975). In 1990, during the crisis that resulted in the Persian Gulf War, Iraq broke international law by using foreign hostages as "human shields" to discourage attacks against military and industrial sites.

The fact that laws are broken does not destroy them as laws. The laws of cities, states, and nations are often broken, but such laws remain an active force. No nation denies the existence of international law.

Courts and arbitration. In the belief that arbitration is a better method than war to settle disputes, the Permanent Court of Arbitration was established in 1899 at The Hague, the Netherlands. Members of the court serve as arbitrators, not as judges.

In 1920, the League of Nations set up the Permanent Court of International Justice. The United Nations took over the court in 1946 and renamed it the International Court of Justice. This court issues judgments on boundary disputes and other questions of international law. Nations are not required to use the court, but they must accept its decisions if they do use it.

In 1998, 120 UN member nations approved a treaty calling for the creation of another UN court, the International Criminal Court (ICC), for the prosecution of war crimes and other offenses. The treaty took effect in 2002.

Punishment. There is no uniform way to enforce international laws. Laws within countries provide penalties for those who break them. But in the society of nations, no individual nation has the power to punish other nations or to force them to submit their disagreements to courts of arbitration. If an aggressor refuses to arbitrate, an injured nation may resort to self-help, which may mean war. But when the aggressor is strong and the injured nation is weak, such action is not practical. Treaties for united action, such as the North Atlantic Treaty, provide help for weaker nations in such cases. The UN Charter provides for collective defense.

The trials of German and Japanese leaders at Nuremberg and Tokyo after World War II were an important

step in the development of international law. Some of the leaders were charged, not only with breaking the laws of war, but also with bringing about the war itself. The idea that international laws will be enforced by punishing those people who break them represents an important addition to the theory of international law. The International Law Commission of the United Nations has given much study to improved ways of formulating and enforcing international law.

History

In early days. For thousands of years, international law consisted only of customs and treaties made by two or three nations. In the 1600's, Hugo Grotius, a Dutch statesman, expressed the idea that all nations should follow certain international rules of conduct. For this idea and his writings on the subject, Grotius is often called the father of international law.

In the 1800's, international conferences were held to try to set up rules nations would obey in time of war. The first important conference met at Geneva in 1864. It established the International Red Cross and made rules for the humane treatment of the wounded and the safeguarding of the noncombat personnel who cared for them. The Geneva Convention showed that rules could be written for nations to follow.

As a result of international conferences held at The Hague in 1899 and 1907, the laws of war, of peace, and of neutrality were collected and embodied in 14 conventions. They covered such subjects as the rights and duties of neutrals in case of war on land and in naval war, and the peaceful settlement of international disputes. Only 12 nations signed the first Geneva Convention. But 44 nations met at the Hague Peace Conference of 1907, and most signed many of the conventions.

After World War I, many persons hoped that the League of Nations, established in 1920, would be able to enforce international law and prevent a second world war. Under the Covenant of the League of Nations, members were not allowed to go to war until three months after an arbitration court or the Council of the League had tried to end a dispute. But after the Japanese invaded Manchuria in 1931, the League could only condemn the invasion as a breach of international law. Japan then withdrew from the League and continued to attack China. Italy followed Japan's example in 1935, when Italian troops invaded Ethiopia.

Between 1928 and 1934, more than 60 nations signed the Kellogg-Briand Pact, under which they agreed not to use war to gain their aims. But the pact did nothing about the causes of war. Its failure led many people to believe that nothing could stop wars and that international law should only try to make war less brutal.

After World War II, the United Nations was formed as an organization to preserve the peace. Many people hoped the UN General Assembly might in time become a world legislature that could pass international laws. They believed the UN could profit from the mistakes of the League of Nations and succeed where the League had failed. Most of the nations that signed the UN Charter at San Francisco in 1945 believed the UN should be given the power to enforce its decisions—by force of arms if necessary. The United Nations Security Council was given the authority to determine whether nations were endangering world peace by their actions.

In 1949, UN arbitration succeeded in stopping a war in Israel. In 1950, the UN became the first world organization to use force to stop aggression. Communist forces from North Korea invaded the Republic of Korea in June 1950, and the UN Security Council agreed on a "police action." Sixteen UN countries sent armed forces to aid South Korea, with the United States and South Korea providing most of the troops and supplies. After the UN forces drove the Communists back into North Korea, a truce was signed in July 1953.

The UN has continued its efforts to resolve conflicts in disturbed regions, such as the Near East and Southeast Asia. But many nations have tended to favor direct negotiations with one another instead of discussion through the UN. In 1969, for example, the United States and the Soviet Union began the Strategic Arms Limitation Talks. In 1972, those talks led to major agreements that limited each nation's defensive and offensive nuclear missiles.

Efforts by the UN and direct negotiations among nations have helped lessen the danger of war. But governments have failed to create a system of international law that prevents nations from using force to achieve their aims. Many countries have used such force. For example, the Soviet Union sent troops into Hungary in 1956 and into Czechoslovakia in 1968 to ensure that both nations would remain Communist. During the Vietnam War (1957-1975), the United States fought in an unsuccessful attempt to prevent the Communist take-over of South Vietnam. In the Persian Gulf War (1991), a U.S.-led coalition of nations drove Iraqi troops from Kuwait after Iraq had invaded that country in 1990. The coalition's actions were based on a number of UN Security Council resolutions. Robert J. Pranger

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Intervention
Neutrality
Nuremberg Trials
Peace
Political prisoner
Port of entry
Right of search
Territorial waters
Treaty
War
War crime

Additional resources

Fox, James R. *Dictionary of International and Comparative Law.* 2nd ed. Oceana, 1997.
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International Maritime Organization, a specialized agency of the United Nations, promotes cooperation among governments in matters involving international shipping. The organization, commonly known as IMO, works to establish international shipping regulations designed to raise safety standards and to prevent pollution from ships. It also furthers the exchange of technical information on ocean shipping.

About 150 countries, including the United States and Canada, belong to IMO. Representatives from these countries attend IMO meetings, which deal with such subjects as navigation safety, ship design and equipment, crew standards, and pollution control. An increasingly important concern of IMO is technical assistance to help developing countries operate maritime programs that meet international standards.

The agency began in 1959 as the Inter-Governmental Maritime Consultative Organization. It took its present name in 1982. IMO headquarters are in London.

Critically reviewed by the International Maritime Organization

International Monetary Fund (IMF) is an organization that provides short-term credit to its more than 175 member nations. The IMF works to maintain orderly payment arrangements between countries and to promote growth of the world economy without inflation. It supports free trade in goods and services. To stabilize its members' economies, the IMF provides policy advice and short-term loans when a member nation encounters financial difficulty.

To receive IMF loans, members usually must change their economic policies. For example, the IMF may insist that the borrowing country reduce its budget deficit and sharply raise interest rates to reduce inflation. It may also suggest that a member devalue its currency to make its exports more competitive in world markets.

Policies required by the IMF often cause short-term political unrest or economic hardship within the country that adopts them. However, these policies offer important longer-term benefits. They generally stabilize the nation's economy, reduce inflation, and eventually create an economic environment favorable to growth.

By lending money to a member, the IMF reassures private banks and investors that it is safe for them to put money in the country. IMF loans often encourage the extension of existing bank loans and other private credits.

Plans for the IMF were made at the Bretton Woods Conference in 1944. The IMF began operating in 1947. The United States contributed about a third of the new organization's assets. In 1969, the IMF created a type of money called *Special Drawing Rights* (SDR's) to supplement reserves of gold and currency. IMF members can transfer SDR's among themselves to settle debts.

Officially, the IMF is a specialized agency of the United Nations. But in practice, the United States, the United Kingdom, Germany, France, Japan, and Saudi Arabia govern the fund. In its early years, the IMF acted as a meeting place for the industrial nations to discuss their trade relationships and financial dealings with one another. In the 1970's, the fund began focusing on the problems of less developed nations. In the 1990's, the focus shifted toward financial crises in such nations as Indonesia, Mexico, South Korea, and Thailand and in former Communist countries, such as Russia and Ukraine.

The fund is closely connected with the World Bank, the international agency that offers long-term credit to its member nations. A country must be a member of the IMF before it can belong to the World Bank. The IMF has headquarters in Washington, D.C. Gary Hufbauer

See also **Bretton Woods; Special Drawing Rights; World Bank.**

International Olympic Committee (IOC) is the organization that oversees the Summer and Winter Olympic Games. The IOC approves the sports and events to be included in the Olympics and determines what city will host the games by a majority vote of its members. The IOC has headquarters in Lausanne, Switzerland.

Although the IOC oversees the Olympics, it does not actually run the games. The responsibility for operating the competitions themselves lies with the international federations of each sport. For example, the Fédération Internationale de Natation (FINA) conducts swimming events, and the International Skating Union runs the skating competition. The host city handles such responsibilities as the creation and operation of sports facilities, security, and the housing of athletes.

In 1998, investigators found that IOC members had traded their votes for money and favors from potential host cities. The IOC responded to the scandal with a series of reforms, including restrictions on visits to host cities and the addition of active athletes to the IOC.

Created in 1894, the IOC originally had 15 members. By 2001, the number had grown to over 125. The most influential founding member of the IOC was Baron Pierre de Coubertin of France, who served as the IOC president from 1896 to 1925. David Wallechinsky

See also **Olympic Games** (The International Olympic Committee).

International Peace Garden is a park that honors the long friendship between Canada and the United States. It lies in both countries. It is on the Canadian-United States border between Boissevain, Manitoba, and Dunseith, North Dakota. Features of the park include a formal garden, lakes, nature trails, camping grounds, and picnic areas. The International Music Camp, a summer school of fine arts, is held at the park. It offers instruction to young people and adults in painting, dancing, and other fine arts, as well as in music.

The International Peace Garden was established in 1932. The garden is controlled by a nonprofit corporation and receives funds from both private and government sources.

Critically reviewed by the International Peace Garden, Inc.

International phonetic alphabet. See **Phonetics.**

International relations traditionally have consisted of official contacts among the governments of independent countries. Such contacts may be peaceful or warlike. Most national governments maintain peaceful relations with one another through special representatives who work to promote international cooperation.

The term *international relations* has come to describe many other kinds of international contact besides relations among governments. These contacts include the dealings of *multinational corporations* (businesses that operate in two or more countries) and such worldwide programs as the Red Cross and the United Nations Children's Fund (UNICEF). International relations also involve such activities as the movement of people and the increased flow of trade between countries. The Internet has made it easier for groups and individuals in different countries to conduct relations with one another.

Governments usually try to cooperate with one another because such problems as pollution and the spread of disease affect the people of all nations. These problems cannot be solved by one government acting alone, and so governments work together to deal with them.

No world government has the authority to force na-

tional governments to cooperate. The government of every independent state is *sovereign*—that is, it recognizes no authority higher than its own. Legal sovereignty does not ensure actual sovereignty, however. Different levels of economic development and military capacity among countries prevent some nations from acting as they choose. In certain cases, rulings by international courts may also compromise a nation's sovereignty.

Conducting international relations

Countries maintain peaceful international relations by a number of methods, including diplomacy, international conferences and organizations, treaties, and international law. They also try to influence each other by using economic and other nonmilitary sanctions.

A number of limited wars have occurred since World War II ended in 1945. But most governments work hard to solve their problems and settle their disputes by dealing peacefully with one another. Their leaders know that much of civilization could be destroyed if a limited war grew into a general war involving nuclear weapons.

Diplomacy. Traditionally, governments have maintained relations with each other through diplomats. Governments usually send diplomats to serve in other countries. *Ambassadors* (high-level representatives) and other diplomats carry on daily relations between their home government and the government of the country where they serve. They protect the rights of fellow citizens abroad and work toward political advantages for their government. They may settle international disputes through *negotiations* (discussions).

Every nation has an office for the conduct of foreign affairs. In the United States, this office is the Department of State. A nation's office of foreign affairs supervises the government's relations with other governments. This office assigns diplomats to other countries and sends representatives called *consuls* to foreign cities. Consuls work to promote and protect the economic interests of their fellow citizens who are abroad.

Governments also communicate with each other by allowing their statements to be broadcast on television or distributed through other forms of mass media. This use of TV and other media has reduced the traditional role of diplomats somewhat.

International conferences and organizations. International problems may involve many countries, or several disagreements may have to be settled at the same time. To deal with such problems, governments may send diplomats or other representatives to an international conference. Between 1967 and 1982, for example, the United Nations (UN) sponsored a series of meetings to draw up an international treaty governing the development and protection of the oceans. In some cases, two or more heads of government may hold a *summit conference*.

Most nations belong to the UN and send delegates to this international organization. The delegates discuss ways of solving problems and promoting world peace. The Security Council is the UN's main peacekeeping agency. It may call on UN members to end contacts with a country that is endangering world peace. It also may ask UN members to furnish military forces to settle an international dispute. Such international peacekeeping forces have grown in number since 1985.

Treaties. A treaty is a formal agreement made by national governments. The agreement may be *bilateral* (signed by two countries) or *multilateral* (signed by more than two countries). Only the official representatives of independent countries may draw up a treaty. Before the agreement can go into effect, it must be approved by the governments of the countries involved.

A nation may sign a treaty to promote its economic interests. For example, two or more governments may agree to remove tariffs and other trade barriers between their countries. In the 1950's, some European countries signed such treaties to form the European Economic Community, an organization that was incorporated into the European Union in 1993 (see **European Union**).

Governments may sign *treaties of alliance* to provide military protection for their countries. Such a treaty may require that the signing countries help one another if any of them is attacked. In 1949, the United States, Canada, and a number of European nations signed a treaty of alliance called the North Atlantic Treaty. Since the breakup of the Soviet Union in 1991, a number of former Soviet republics also have signed this treaty.

Countries may sign *arms-control treaties* to limit, regulate, reduce, or eliminate their weapons or armed forces. Since 1960, the United States and other countries have signed a number of treaties designed to control nuclear weapons.

International law consists of rules that governments are expected to observe in their relations with one another. Some rules have developed through custom. Others have been established in treaties.

International law originally dealt with issues of war and peace. Since then, it has expanded to include such topics as economic relations and environmental concerns. The oldest international regulations treat such matters as the rights of people traveling abroad, the rights of merchant ships outside their own waters, and

Gamma

Secret negotiations between Henry A. Kissinger of the United States, *left,* and Le Duc Tho of North Vietnam, *right,* resulted in the 1973 agreement that ended U.S. participation in the Vietnam War. The meetings were held in Paris.

the rights of aircraft flying through foreign airspace. The International Court of Justice, an agency of the UN, settles certain international disputes on the basis of international law. But no country has to appear before the court unless it wishes to do so. In 1998, 120 UN member nations approved a treaty calling for the establishment of another UN court, the International Criminal Court (ICC), for the prosecution of war crimes and other offenses.

Nonmilitary sanctions may be used by one country to pressure another country to change its policies. Such sanctions include *boycotts* and *embargoes*. In a boycott, a government may prohibit its people from buying another nation's products. Other boycotts involve a refusal to participate in sporting events or other activities. In an embargo, a government restricts or discontinues its trade with another nation. Sanctions also include the suspension of financial assistance.

History

Many historians believe that extensive international relations began during the 1500's, when strong national governments were being established in Europe. The term *international relations* came into use in the 1700's.

From the 1500's to the 1900's, the *balance of power* was an important principle in international relations. Governments used this principle to maintain international peace. If any nation seemed too powerful, a group of weaker nations formed a temporary alliance against it.

England and its successor, the United Kingdom, provided a balance of power in Europe for much of the period from the 1500's to the 1900's. If two countries or groups of countries threatened each other, the United Kingdom joined the weaker side to maintain the power balance. During the early 1800's, Napoleon I of France built a huge empire and upset the balance of power. Several countries, including the United Kingdom, formed an alliance against France. Their victory over the French in 1815 restored the balance of power.

From late 1814 through early 1815, European leaders held a series of meetings called the Congress of Vienna and developed a new principle of conducting international relations. Under this principle, called the *concert of powers,* the great powers of Europe supposedly cooperated to keep peace. But they did not always agree on what to do. As a result, several wars broke out in Europe between 1815 and the start of World War I in 1914.

Collective security, a new principle of international relations, developed after World War I ended in 1918. Representatives of 32 countries met near Paris in 1919 to draw up a peace settlement. They originated the idea of *collective security,* in which each member of a group of nations agrees to come to the aid of any other member if that nation is attacked. The governments also would settle international disputes through discussion.

The League of Nations was established in 1920. This association of countries hoped to maintain world peace through collective security. But the League failed to keep the peace. It took no effective action after Japan attacked China in 1931 and again in 1937. It also did nothing to stop Italy from conquering Ethiopia in 1936, or Germany from taking over Austria in 1938. World War II began in 1939 after Germany invaded Poland.

The League failed partly because it had no international police force to keep one country from attacking another. Also, all member nations had an equal say in decisions, and the larger and more powerful members often refused to support the decisions of the majority. The United States refused even to join the League.

The UN was established in 1945, shortly after the war ended. The League of Nations was abolished in 1946. All UN members, including the United States, pledged to cooperate in maintaining peace through collective security. But they did not give the UN the means—that is, a permanent police force—to back up their promise.

The UN came close to making collective security work during the Korean War, which began in 1950. The United States and 15 other UN members sent troops to fight the North Korean forces that had invaded South Korea. The Korean War ended in 1953 after North Korea and the UN signed a cease-fire agreement.

The Cold War begins. After World War II, relations became increasingly tense between the United States and the Soviet Union, the world's most powerful countries. In the 1940's, many people in the United States and other Western countries became alarmed as all the nations of Eastern Europe fell under Communist rule. Most of these nations became *Soviet satellites* (nations controlled by the Soviet Union). Tension between the Communist and non-Communist nations led to the division of Germany into Communist East Germany and non-Communist West Germany in 1949.

Also in 1949, the United States, Canada, and certain European nations signed the North Atlantic Treaty. Later that year, they established the North Atlantic Treaty Organization (NATO), which provided unified military leadership for their defense. In 1955, the Soviet Union and its Eastern European allies signed the Warsaw Pact to provide for their common defense. The signers claimed they drew up the pact in response to NATO's creation. By the end of the 1950's, the United States and the Soviet Union each had enough nuclear weapons to destroy the other, and many countries had allied themselves with one of the two nations. The struggle between Communist and democratic nations came to be called the Cold War. But some countries refused to join either side.

The Vietnam War also involved conflict between Communists and non-Communists. The war began in 1957. North Vietnam's Communist government vowed to overthrow the non-Communist South Vietnamese government and unite the country under one rule. The United States sent military aid and advisers to support South Vietnam. By April 1969, over 543,000 U.S. troops were fighting in South Vietnam. A cease-fire agreement ended U.S. participation in 1973. But the war continued until Communists won full control of South Vietnam in 1975.

New patterns of international relations developed during the late 1960's and the early 1970's. Japan and the Western European nations grew in economic strength. As a result, they began acting more independently of their chief ally, the United States. China also gained economic and political strength and disagreed with its ally, the Soviet Union, on many points. A period of unfriendly relations between China and the Soviet Union began in the early 1960's. In 1969, Chinese and Soviet troops clashed in a series of border fights.

As Cold War alliances loosened, some Communist and non-Communist countries developed friendlier relations. This easing of tensions was called *détente* (pro-

Wide World

The United Nations was established at an international conference in San Francisco in 1945. President Harry S. Truman of the United States, *right,* addressed the final session.

nounced *day TAHNT).* The United States, plus Canada, Japan, and several other U.S. allies, sent diplomats to China. China joined the UN in 1971. In 1979, China and the United States began normal diplomatic relations. This action resulted in increased business, cultural, and diplomatic exchanges between the two countries.

The Cold War ends. During the late 1980's, U.S.-Soviet relations began to improve dramatically. In 1987, U.S. President Ronald Reagan and Soviet leader Mikhail Gorbachev signed the first of a series of agreements to reduce the size of U.S. and Soviet nuclear forces. Major economic and political changes within the Soviet Union also contributed to improved relations. Gorbachev worked to increase democracy and freedom of expression. He encouraged similar changes in Eastern Europe. As a result, non-Communist governments came to power in some Eastern European nations. In 1990, with Soviet approval, East and West Germany united to form one non-Communist country.

The collapse of the Soviet Union. In 1991, the Communist Party of the Soviet Union lost control of the Soviet government after conservative Communist officials attempted to overthrow Gorbachev. The attempt failed, and the Soviet parliament suspended all Communist Party activities. By the end of 1991, most of the republics that made up the Soviet Union had declared independence, and the Soviet Union ceased to exist.

The Arab-Israeli conflict. International peacekeeping and cooperation have achieved some success since World War II, but local wars continue to break out. One of the most difficult conflicts to solve has been the struggle between Arab countries and Israel. The Arab-Israeli conflict began in 1948, when Israel was established. Neighboring Arab countries opposed the existence of the new Jewish nation. Full-scale wars broke out in 1948, 1956, 1967, and 1973. Despite peacekeeping efforts, tensions between Arab countries and Israel have continued into the 2000's. The Arab-Israeli wars and local wars in other parts of the world have led many experts to believe that lasting peace is almost impossible.

The Persian Gulf War took place after Iraqi forces invaded and occupied Kuwait in August 1990. Kuwait is a small, oil-rich country bordering Iraq and Saudi Arabia. In response to Iraq's action, the UN Security Council first imposed severe economic sanctions against Iraq and later authorized UN members to use military force to expel Iraq from Kuwait. In early 1991, a coalition of 39 nations quickly defeated Iraq and drove it from Kuwait. The war strengthened the UN's role as a peacekeeping organization.

The Balkan conflicts. A series of conflicts occurred on the Balkan Peninsula after the 1991 breakup of Yugoslavia. In the mid-1990's, NATO troops occupied Bosnia-Herzegovina to maintain peace between hostile ethnic groups there. In 1999, NATO engaged in air strikes against Serbia in an attempt to stop Serbian persecution of Albanians in Kosovo. Many people praised these efforts as examples of a "new internationalism."

Globalization. This new internationalism includes the concept of *globalization.* Globalization involves an increase in international economic transactions and increased worldwide communication. By 2000, some people saw globalization as the wave of the future. However, others warn that it will have harmful effects. They fear it will enable powerful nations to take advantage of weaker ones, give excessive power to corporate interests, and interfere with the governmental processes of individual countries.

The war against terrorism. On Sept. 11, 2001, terrorist attacks in the United States killed thousands of people, including the citizens of many different countries. Following the attacks, the United States formed an international diplomatic coalition against international terrorist groups. In October, the United States began military strikes against Afghanistan, the country containing the headquarters of the terrorists believed to be responsible for the attacks. The UN Security Council also adopted a resolution requiring all member nations to take steps against international terrorism. Both the UN Security Council and the UN General Assembly stressed that governments that sponsor, assist, or protect terrorist groups will be punished. Michael P. Sullivan

Related articles in *World Book* include:

Organizations

African Union
Alliance for Progress
Arab League
Asian Development Bank
Bank for International Settlements
Common market
European Free Trade Association
European Union
General Agreement on Tariffs and Trade
International Atomic Energy Agency
International Court of Justice
International Monetary Fund
Inter-Parliamentary Union
League of Nations
North Atlantic Treaty Organization
Organization for Security and Cooperation in Europe
Organization of African Unity
Organization of American States
Southeast Asia Treaty Organization
United Nations
Warsaw Pact
World Bank

Other related articles

Ambassador
Arbitration (International arbitration)
Arms control
Balance of power
Cold War
Consul
Diplomacy
Foreign aid
Foreign policy
Geopolitics
Globalization
Helsinki Accords
International law
International Space Station
International trade
Multinational corporation
Nonaggression pact
Pan-American Conferences
Peace
Reciprocal trade agreement
Sanctions, Economic
State, Department of
Strategic Arms Limitation Talks
Strategic Arms Reduction Treaty
Treaty
War

Additional resources

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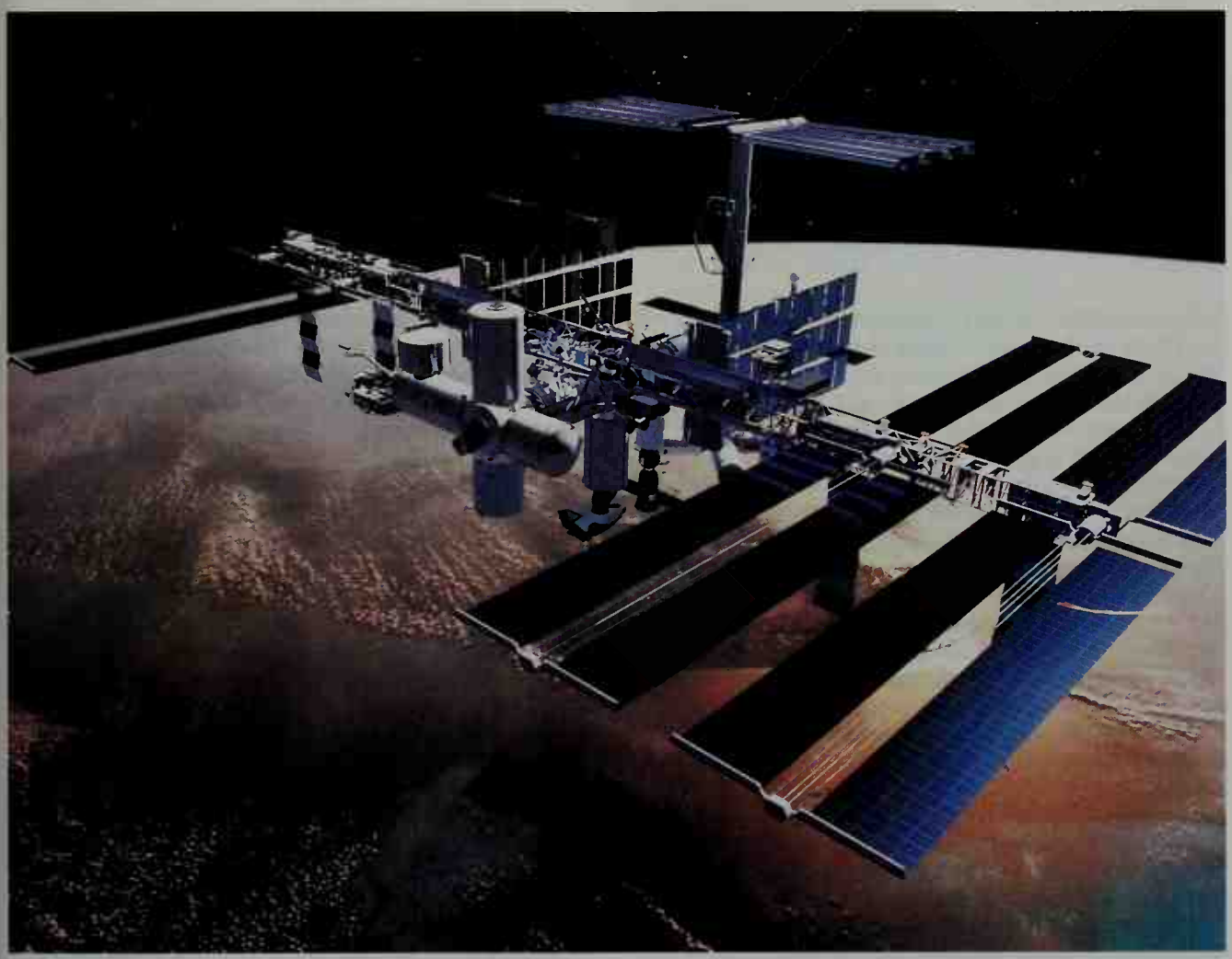
Ziring, Lawrence, and others. *International Relations.* ABC-Clio, 1995.

International Settlements, Bank for. See Bank for International Settlements.

International Space Station is a large, inhabited Earth satellite that more than 15 nations are building in space. The first part of the station was launched in 1998, and the first full-time crew—one American astronaut and two Russian cosmonauts—occupied the station in 2000.

The International Space Station orbits Earth at an altitude of about 250 miles (400 kilometers). The orbit extends from 52° north latitude to 52° south latitude.

The station will include about eight large cylindrical sections called *modules.* Each module will be launched from Earth separately, and astronauts and cosmonauts



NASA

The International Space Station will function as an observatory, laboratory, and workshop. Astronauts and cosmonauts will live and work in cylindrical modules, and solar panels will furnish electric power. Over 15 countries are building the station, shown here as it will look when finished.

NASA

The Zvezda (Star) module, built in Russia, provides living and working quarters for the crew of the space station. Cosmonauts Sergei K. Krikalev, *left,* and Yuri P. Gidzenko work in Zvezda.

NASA

The Destiny Laboratory Module, built in the United States, provides research facilities. Expedition One mission commander William M. Shepherd, *right,* works with astronauts Marsha S. Ivins and Kenneth D. Cockrell in the Destiny module.

will connect the sections in space. Eight solar panels will supply more than 100 kilowatts of electric power to the station. The panels will be mounted on a metal framework 360 feet (109 meters) long.

The United States and Russia are providing most of the modules and other equipment. Canada built a mobile robot arm, which was installed in 2001. Other participants include Japan and the 11 member nations of the European Space Agency (ESA)—Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom. Brazil signed a separate agreement with the United States to provide equipment. In exchange, Brazil will have access to U.S. equipment and permission to send a Brazilian astronaut to the station.

More than 80 flights of the U.S. space shuttle and Russian rockets will be necessary to complete the International Space Station. The ESA and Japan plan to develop supply vehicles to be launched on the ESA's Ariane 5 and Japan's H-2A booster rockets. The space station was originally scheduled for completion in 2006, but unpredicted expenses have created major delays.

Missions. The crew and scientists on Earth—using radio signals—operate laboratory equipment on the station. Some of the equipment measures the effects of space conditions, such as apparent weightlessness, on biological specimens—including the crew. Other equipment produces various materials, including protein crystals for medical research. Crystals grown in space have fewer imperfections than those grown on Earth and are therefore easier to analyze. Medical researchers will use results of protein analyses to determine which crystals to mass-produce on Earth.

The major value of having a space station is that all the equipment needs to be carried into space only once. Also, the station can be used again and again by visiting astronauts and cosmonauts. Scientists on Earth can analyze experimental results and modify follow-up investigations in a much more timely manner than before. The station has been designed to operate for at least 15 years. But it could last for decades if parts are repaired and replaced as they wear out or are damaged.

History. The International Space Station is the ninth inhabited space station to orbit Earth. The first such stations, consisting of six models of the Soviet Salyut station and the U.S. Skylab, were launched in the 1970's.

In 1986, the Soviet Union began operating Mir, the first space station to use a modular design. The Soviets developed a reliable, economical transportation system, based on Soyuz spacecraft, for the station. The system enabled them to deliver supplies, equipment, and crew members to Mir. Following the collapse of the Soviet Union in 1991, Russia took over the operation of Mir. Russian cosmonauts handled major breakdowns on the station, which was wearing out. In March 2001, Russia took Mir out of orbit and sent it plunging to Earth.

Russia had intended to construct a station known as Mir 2 in the 1990's. The United States had planned to build a station called Freedom in partnership with space agencies in Europe, Canada, and Japan. But due to funding difficulties, the United States and Russia agreed in 1993 to build a combined station—the International Space Station.

To prepare for the project, shuttles flew to Mir from 1995 to 1998. United States astronauts served on board the Russian station as researchers for as long as six months.

Major delays occurred in the construction of the International Space Station due to cutbacks in funding by the Russian government. A Russian Proton rocket finally launched the first module in November 1998. The module was a Russian-built and United States-funded unit called Zarya or the FGB. *Zarya* means *sunrise* in Russian, and *FGB* stands for *functional cargo block.*

The second module, Unity, was built by the United States. The space shuttle Endeavour carried Unity into orbit in December 1998, and it was then joined to Zarya. Unity has six hatches. One is connected to Zarya, and others serve as connectors for other modules.

In July 2000, a Proton launched the Russian-built Zvezda (Star), or Service Module. Zvezda has living and working quarters for astronauts and cosmonauts. In October 2000, the shuttle Discovery carried up several more pieces. Those included a support truss for solar arrays and a connecting unit called a Pressurized Mating Adapter (PMA). The PMA provided a docking port for shuttles.

The first full-time crew, known as Expedition One, arrived in a Soyuz in November 2000. The crew commander was astronaut William Shepherd, and the other members were cosmonauts Yuri Gidzenko and Sergei

Krikalev. Later that month, Endeavour carried the first four U.S.-built solar panels into space to supplement the small panels on the Russian modules.

The shuttle Atlantis carried the U.S.-built Destiny Laboratory Module to the station in February 2001. Over the next few months, Destiny was activated, and scientific research began. Also in 2001, two additional modules—a U.S. airlock and a Russian airlock and docking port—were added.

In April 2001, the Russians included a paying passenger in a Soyuz-replacement mission. Dennis Tito, an investment consultant from California, bought the "ticket" for an undisclosed price. He trained in Moscow for six months before the flight and spent six days aboard the station. Later Soyuz missions carried one or two Russians, paying passengers from the ESA, and more "space tourists."

The next stages of construction were to expand the station's power and life-support systems to support a full-time crew of six or seven. To provide emergency return capability for a crew that large, NASA planned to build a seven-person escape craft. But during 2001, it became clear that NASA had greatly underestimated the cost of developing and operating the station. NASA's cost for the station was about $5 billion over budget. As a result, NASA suspended the plan to enlarge the crew and build the escape craft. NASA's partners in Europe and Japan strongly objected to that decision.

In 2002, the station continued to operate with a crew of three. Space shuttles replaced the crew every four or five months. Russian cosmonauts also flew a new Soyuz spacecraft to the station every six months. The Soyuz would serve as a "bail-out capsule" in case of a life-threatening emergency. The expansion of the power system continued, but more slowly than originally planned. James Oberg

See also Space exploration (Space stations).

International standard book number is a group of 10 numbers identifying a book and its publisher. International standard book numbers, which are also called ISBN's, simplify book ordering processes. Booksellers, librarians, and others who handle many books can send and receive orders faster and more efficiently, using ISBN's.

An international standard book number has four parts, separated by hyphens or spaces. The first group of numbers is called the group identifier. It represents the geographical or language group of a book. For example, 0 is the group identifier for the English language. The second group of numbers is called the publisher prefix. It represents the publisher of a book. The third group of numbers, called the title prefix, represents the title of a book. The last number is a check *digit* (number less than 10). As the international standard book number goes through a computer, the check digit indicates errors that may have been made when the number was handwritten.

The standard book number system was first used in the United Kingdom in 1967. Following general agreement among publishers, the United States adopted the system later that year. In 1969, the International Organization for Standardization officially accepted ISBN's.

International Style. See Architecture (The International Style; picture).

International Telecommunication Union (ITU) establishes regulations on the international use of radio, satellite, telegraph, and telephone communication services. It is a specialized agency of the United Nations with over 180 members. The International Telecommunication Union prepares technical and scientific studies designed to improve means of communication. ITU consists of an administrative council of 46 member nations, a secretariat, an International Frequency Registration Board, and two consultative committees. It usually holds a conference of all members every five years. ITU developed from the International Telegraph Union, established in 1865. Headquarters are located in Geneva, Switzerland.

Critically reviewed by the International Telecommunication Union

International trade is the exchange of goods and services between countries. It is distinguished from *domestic trade,* which takes place entirely within a single country. International trade is sometimes called *world trade* or *foreign trade.* International trade permits countries to specialize in producing the things they are best suited to make with the resources they have. Countries benefit by producing the goods they can make most cheaply, and buying the goods other countries can make more cheaply. International trade makes it possible for more goods to be produced and for more human wants to be satisfied than if each country tried to produce everything that it needed within its own borders.

By the late 1990's, world merchandise trade, as measured by exports, exceeded $4 trillion a year. World exports of commercial services totaled more than $1 trillion annually. The world's leading exporters of goods and services are the United States, Germany, Japan, France, and the United Kingdom. Most world trade is carried out by private exporters and importers, and only a small part is handled by governments.

The U.S. and world trade. The United States is one of the world's leading trading nations. Its thriving export trade helps the country achieve high levels of income and employment. The jobs of thousands of American workers, the profits of many businesses, and the incomes of many farmers depend on how U.S. products and services sell in other countries. The United States exports much of its annual production of such agricultural commodities as cotton, soybeans, tobacco, and wheat. Businesses producing computer equipment, aircraft, machinery, and other high-technology products also export much of their output.

Imports also aid the economy. Americans import many raw materials and foods that they either cannot produce at all or cannot produce in sufficient quantities. These goods include coffee, tea, bananas, sugar, copper, iron ore, nickel, and petroleum. The United States also imports many kinds of manufactured consumer goods such as textiles and clothing, and durable goods such as steel, automobiles, and machinery. Because these goods can be produced more cheaply in other parts of the world, Americans can buy them at lower prices than if the goods were produced in the United States. In addition, United States exports enable people in other countries to obtain certain goods at lower prices.

International trade is a two-way process. For example,

Porterfield-Chickering, Photo Researchers

International trade involves the exchange of goods and services between nations. Ships enter the port of Barcelona, Spain, *shown here,* with machinery and raw materials from many countries. They leave carrying automobiles, wine, and other Spanish products.

when Americans buy British goods, they supply the British with dollars that can be used to buy U.S. goods. If a country wishes to sell to other countries, it must also buy from other countries.

Why nations trade. Trade takes place between nations for the same reasons it is carried on within a country. For example, trade between Australia and Japan is similar to trade between Wyoming and Rhode Island. In both cases, regions specialize in producing particular goods because they have resources that make such specialization sensible and profitable. Both Australia and Wyoming have abundant space and few people. This is the best combination of resources for efficient cattle raising. Japan and Rhode Island have little space, but they have much skilled labor and capital. Such a combination makes for efficient industrial production. Australia and Wyoming specialize in cattle and sell meat to Japan and Rhode Island, respectively. On the other hand, Japan and Rhode Island specialize in industrial products and sell them to Australia and Wyoming.

Goods are bought and sold on the basis of their price. People want to buy the cheapest goods available. These goods will be made in nations that can produce them at low cost. For this reason, Japanese industrial goods will be priced lower than similar Australian products.

World trade benefits people in two chief ways. First, consumers can get more goods at lower cost through specialization and exchange than if every country tried to be self-sufficient and make everything it needed. Second, scarce resources can be used more efficiently if each nation makes mainly those things it can produce more efficiently than other countries. The economic principle of *comparative advantage* states that each country should concentrate on making those goods it can produce most efficiently and buy from other nations those goods it cannot make as efficiently.

The greatest volume of international trade takes place between the advanced industrial countries. This trading happens because many of the people in those countries earn enough money to purchase large amounts of goods, and because those countries have the most specialized industries. For example, the United States exports aircraft and computer equipment to Japan. In turn, the United States imports automobiles, stereo equipment, and color televisions from Japan.

Government trade policies influence the volume of trade between nations. In domestic trade, goods may move freely from one part of a nation to another. In international trade, governments often place artificial barriers against the free movement of goods from one country to another. One such barrier is a tax on imports called a *tariff,* usually part of a system of *import duties* levied on goods coming into the country. The tariff makes these goods more expensive and thus encourages consumers to buy from domestic firms. Another trade barrier, the *quota,* limits the quantity of imports allowed. It generally requires an importer to get a government permit before bringing goods into the country. The practice of establishing trade barriers to help domestic firms is commonly referred to as *protectionism.*

Trade barriers usually reduce the volume of international trade, raise prices to consumers, and deprive nations of the benefits of specialization. All nations create such barriers, however, for several reasons. Local producers and workers, unable to compete with more efficient producers in other countries, pressure their governments to protect them from foreign competition. Also, in some cases, countries prefer not to be dependent on foreign sources in the event of war. They often protect industries considered vital to their national interest, even though the goods could be obtained more cheaply from other countries in peacetime. Historically, less developed countries and Communist nations have imposed trade barriers to promote industrial growth and so reduce their dependence on agriculture or mining. These countries have done so in the belief that industry is the key to modern technology and social institutions, and even military power.

In the decades after the end of World War II in 1945, the United States and other advanced industrialized countries significantly reduced their trade barriers, especially on imports of manufactured goods. This reduction was accomplished through a series of trade negotiations under the General Agreement on Tariffs and Trade (GATT). These negotiations have been continued, and broadened to include services and agriculture, under the sponsorship of the World Trade Organization (WTO), which was created in 1995. In addition, such re-

gional arrangements as the European Union and the North American Free Trade Agreement have eliminated all or many of the trade barriers that once existed between their member countries.

Since the 1960's, many of the developing nations of Asia, Latin America, and Africa have lowered or eliminated their trade barriers to increase their economic productivity and welfare. Russia and other former Communist countries have done the same since the late 1980's and early 1990's. During those years, they began seeking to transform their economies from Communist central planning to market-based capitalism.

Various international organizations cooperate in world trade matters. The most important is the World Trade Organization, which works to promote freer trade in goods and services throughout the world. It administers the General Agreement on Tariffs and Trade and other international trade agreements. The Organization for Economic Cooperation and Development (OECD) was designed largely to aid economic growth in its member countries. OECD members include the United States, Canada, Japan, many Western European nations, and numerous other advanced industrialized countries. The United Nations Conference on Trade and Development (UNCTAD) deals mainly with the problems of less developed countries.

Robert M. Stern

Related articles in *World Book* include:

Asia-Pacific Economic Cooperation
Balance of payments
Common market
Economics (World finance)
Eurodollar
European Economic and Monetary Union
European Free Trade Association
European Union
Exchange rate
Exports and imports
Free trade
General Agreement on Tariffs and Trade
International Monetary Fund
Mercosur
Money (International finance)
North American Free Trade Agreement
Reciprocal trade agreement
Supply and demand
Tariff
Trade
World Trade Organization

Additional resources

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International Trade Commission, United States, is an independent agency of the United States government. Its chief function is to determine whether imports are injuring a domestic industry. It also investigates and reports on tariff and foreign trade matters at the request of the president or the Congress. The commission studies the ways customs laws operate and analyzes conditions of competition between United States and foreign industries. The agency examines import records, claims of unfair competition in import trade, and the possible effects of proposed trade agreements.

The commission was established in 1916 as the U.S. Tariff Commission. It was given its present name in 1975. Six commissioners head the agency. They are appointed to overlapping nine-year terms by the president with the approval of the Senate.

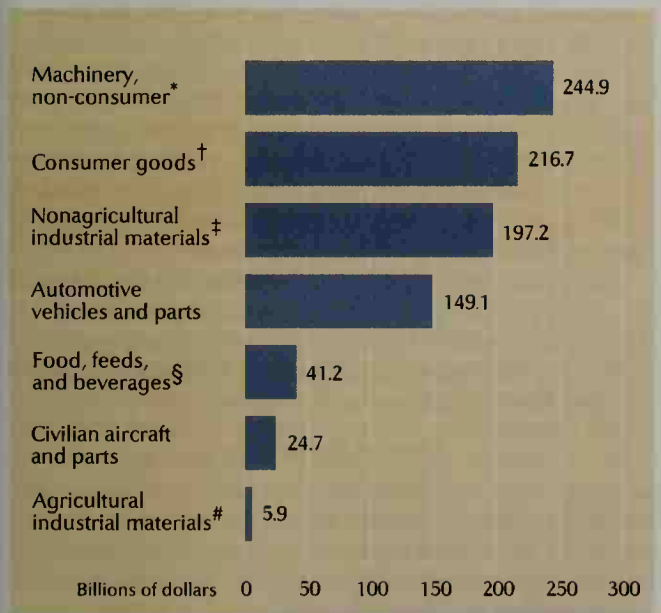
Critically reviewed by the United States International Trade Commission

International waters. See High seas.

Internationale, The, is the song traditionally used by Communist and Socialist revolutionaries. The words of the song were written in 1871 by a French woodworker, Eugène Pottier. The music was composed in 1888 by a Belgian, Pierre Degeyter.

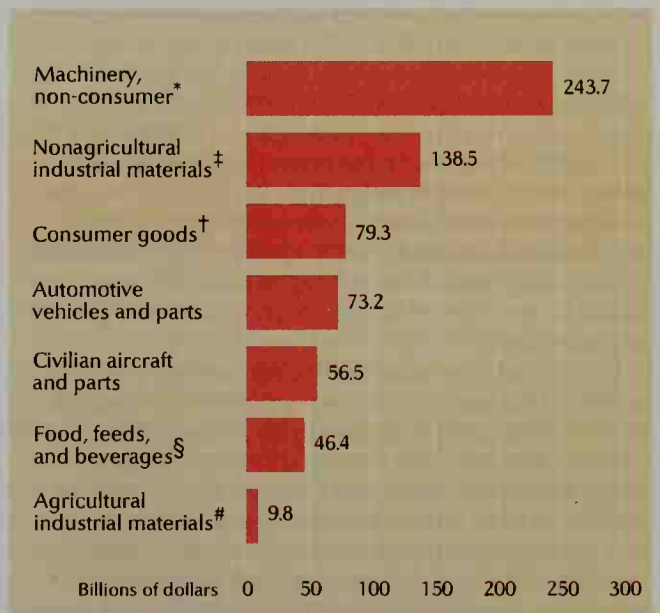
United States foreign trade

Leading imports
Value of commodities imported



*Includes machinery for such fields as mining, agriculture, and telecommunications.
†Includes such items as household appliances, clothing, and toys.
‡Includes such items as chemicals, fossil fuels, metals, and textiles.
Source: U.S. Bureau of Economic Analysis.

Leading exports
Value of commodities exported



§Includes such items as grains, meats, and vegetables.
#Includes such items as raw cotton, tobacco, and hides.
Figures are for 1998.

© Peter Rogers, Getty Images

The Internet makes possible communication that reaches around the world. Individuals may use the Internet to exchange information, perform research, or even shop. At an Internet cafe, such as this one in Beijing, people pay a fee to use the establishment's Internet-ready computers.

Internet

Internet is a vast network of computers that connects many of the world's businesses, institutions, and individuals. The Internet, which is short for *interconnected network of networks,* links tens of thousands of smaller computer networks. It enables users of computers and other networked devices throughout the world to send and receive messages, share information in a variety of forms, and even play computer games with people thousands of miles or kilometers away. Computers linked to the Internet range from simple and inexpensive personal computers, often called *PC's,* to huge *mainframe* computers used by government institutions, educational institutions, and businesses. Other devices linked to the Internet include sophisticated telephones and televisions.

Computers and other devices require special hardware and software to connect to the Internet. Necessary hardware includes a *modem* or an *adapter.* A modem is a device that translates a computer's *digital* (numerical) information into signals that can be transmitted over telephone lines, over cable, or through the air as wireless communications (see Modem). An adapter links a computer to a high-speed communication system designed to carry data in digital form. Adapters are often called *modems,* though they are not true modems. Required software includes a communications program that allows the transmission and receipt of messages. Many computers and computing devices come with modems and communications software installed.

The Internet, often called simply the Net, began as a collection of text-only documents intended for scientists, universities, and some parts of government. But the development and rapid growth of the World Wide Web (also known as the Web) transformed the presentation of information on the Net. The Web is a worldwide system of interconnected computer files linked to one another on the Net. It enables the use of *multimedia*—which includes photographs, moving pictures, and sound as well as text. Multimedia presentations on the Web approach the visual quality of television and the *audio* (sound) quality of recorded music.

The Web consists of millions of *Web sites,* collections of information at specific electronic addresses. Web sites in turn contain *Web pages* that hold multimedia or text-only information. Web sites and their pages reside in computers connected to the Internet.

Uses of the Internet

Today, tens of millions of people and businesses use the Net and the Web daily. The major uses include communications, research, publishing, business transactions, and *push technology,* which employs the Web for the broadcast of video and audio programming.

Communications. Probably the most popular use of the Internet and the Web is sending and receiving

Glossary of Internet terms

Bulletin board is an electronic message center. Most bulletin boards serve specific interest groups. They allow users to read messages left by others and to leave their own as well.
Chat room is a location on the Internet where users can discuss topics of common interest by sending typed messages back and forth. The messages appear as soon as they are typed.
Client is a user's computer.
Cookie is a piece of data placed on a client's hard drive by a server. It can be used for a variety of purposes. One such purpose would be to store a name and password so that a user would not have to enter this information every time he or she returned to the same Web site.
Download is to receive data or software over the Internet and store it so that it may be used later.
E-commerce is a term for business transactions that are carried out over the Internet.
E-mail, or electronic mail, is a way of sending a message over the Internet to another specific user or group of users.
Firewall is a combination of hardware and software that prevents a visitor to an organization's Web site from gaining access to other information stored on the organization's computer network, such as corporate records or employee information.
Home page is the starting page of a Web site. It generally includes tools and indexes to help visitors navigate through the rest of the site. In many ways, a home page functions as an electronic table of contents.
Hyperlink is a programmed connection from one Web site to another. It usually appears on a Web site as a highlighted or underlined word or phrase. When a user clicks a mouse on the passage, the client connects to the related Web site.
Hypertext markup language, or HTML, is the programming language most commonly used by the World Wide Web.
Hypertext transfer protocol, or HTTP, is the set of rules governing the transfer of files between a server and a client. HTTP electronically oversees the connection of clients to Web sites.
Internet service provider is a business that provides a client with the means to connect to the Internet and maintains exchanges of information between clients and servers.
Modem is a device that converts a computer's digital information to signals that can be transmitted over telephone lines, over cable, or through the air. It also converts signals it receives back to digital information.
Net is a common abbreviation for *Internet.*
Network is a communication system that links two or more computers.
Newsgroup, or *forum,* is an online discussion group in which participants with a common interest can exchange open messages.
Online service is a business that provides Internet access plus a wide range of exclusive content and features, such as chat rooms, games, and news reports.
Search engine is a program that allows a user to locate information on the Internet by typing in key words or phrases. The search engine then returns addresses of Web sites that most closely match the request.
Server, or host, is a computer that provides requested resources, such as information or software, to a client via a modem or network connection.
Surfing is the process of visiting a number of Web sites in rapid succession.
Uniform resource locator, or URL, is an electronic address that identifies a Web site.
Web browser, or simply *browser,* is a piece of software that allows a user to access Web sites.
Web site is a collection of information at a specific address on the World Wide Web.
World Wide Web is a worldwide system of interconnected computer files linked to one another on the Internet.

electronic mail, usually called *e-mail.* The number of e-mail messages sent each year far exceeds the number of pieces of traditional mail carried by the world's postal systems.

Individuals, companies, and institutions have e-mail addresses that enable the sending and receipt of mail, just as a street address or post office box provides directions for traditional mail delivery. Users generally acquire e-mail addresses through an *Internet service provider* (ISP) or an *online service.* Both of these types of businesses provide access to the Internet. An ISP maintains its customers' e-mail addresses, routes e-mail and requests for Internet-based information to and from its users, and manages high-speed communications lines that quicken the transfer of data over the Internet. An online service resembles an ISP, but it provides a wide range of exclusive content in addition to Internet access. Most ISP's and online services allow customers to have several different e-mail addresses.

Many e-mail users attach illustrations, sound files, and even videos to their e-mails. An e-mail recipient whose computer system contains the required software can then view and listen to attachments as well as read the text message. Attachments may include charts and graphs, and even the text of entire books.

The Internet easily enables *multiple mailings,* the sending of the same e-mail to many addresses. Businesses advertise products and services via e-mail. *Newsgroups*—loose organizations of people who share a common interest—also use multiple mailings. They send their members copies of e-mail on the subject of interest. Members can respond to those e-mails and may introduce new topics.

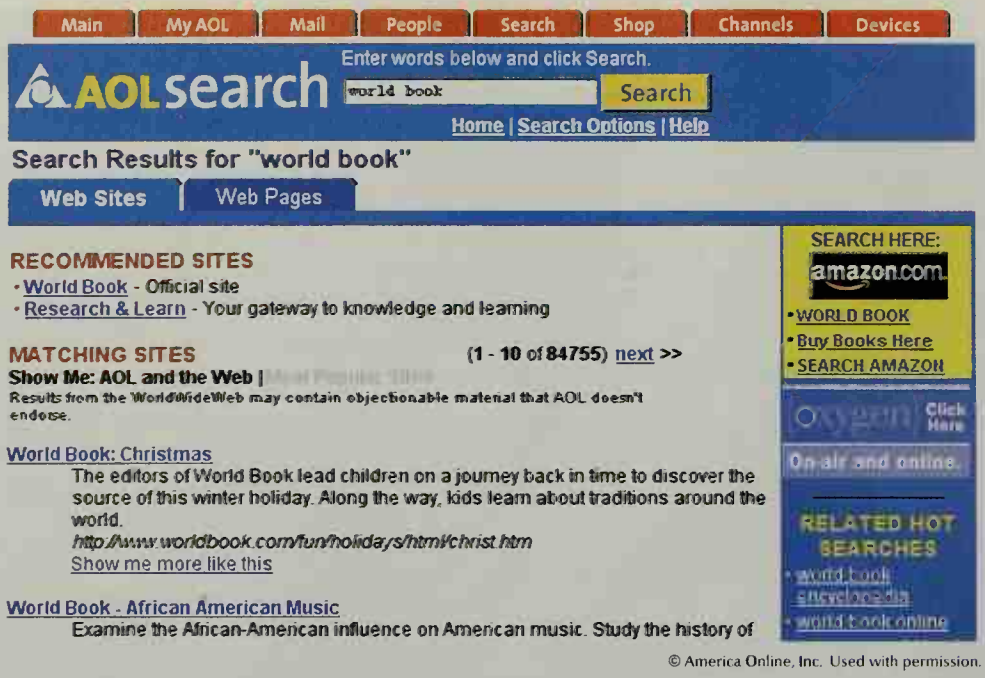
Because much e-mail contains financial and other private information, most e-mail software includes *encryption technology*—programs that convert private e-mail into secret code for transmission. Similar software *decrypts* (translates back into readable language) the code when it reaches its intended destination.

Research. Much of the Internet resembles a vast library, containing as much information on every subject as might be held in tens of millions of books. Information may appear as files consisting only of text or as multimedia displays.

Special types of programs called *search engines* help people sort through the vast amounts of information on the Internet. Web users can choose from many search engines available on Web pages. A search engine allows a user to enter a topic for search, then finds Web pages that match that topic.

Because of the ease with which computers store information, and the speed with which computer users can access it, the Internet serves as a popular first stop for many people investigating a particular topic. A businessperson might search Internet resources for help in developing sales or product information. Students can access databases to find material related to homework assignments. Physicians can use the Net to compare medical treatments and to review advances in medical science. Scientists can share research data on the Net.

Publishing. Publishers increasingly use the Internet as a medium for presenting the contents of newspapers,



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A search engine enables a user to locate Web sites related to a specified topic. The search engine returns results containing links that the user can select to connect to any of the Web sites.

magazines, and books. Because information on the Net is electronic, the publisher saves the costs of paper, printing, and distribution. More importantly, the publisher can update information almost instantly, making it possible to distribute far more current news than could be provided on paper.

Electronic versions of newspapers and magazines often contain more information than a paper publication could include. Web-based publications can also present interactive features. For example, a news story may contain *links* (interactive connections) to related stories or background information. If a reader wishes to explore the linked material, he or she simply clicks on a highlighted word to connect to a Web page containing that information.

The Internet also serves as a distribution system for *e-books* (electronic books). An e-book consists of digital files formatted so that when a reader *downloads* (transfers) them to a special handheld device—or to a computer with special software—the words and pictures appear much as they would on a printed page. A customer can buy e-books at the publisher's Web site or at a site owned by a bookstore. Some electronic library sites maintain collections of text-only e-books. These e-books can be viewed without special devices or software.

Business transactions. Many companies use the Internet to carry out business transactions commonly referred to as *e-commerce*. Retailers sell nearly every type of product over the Internet. Users generally pay for such purchases with credit cards. Software publishers view the Net as a convenient and inexpensive way to distribute their products. Over the Internet, users can buy new computer programs, sample programs before purchasing them, or receive upgrades to programs they already own. Music publishers sell copies of songs as downloadable digital files.

Transactions between companies and consumers are commonly known as B2C (business to consumer) transactions. Additionally, many companies use the Internet to engage in B2B (business to business) transactions. By linking together in a vast network, buyers and sellers can share information, keep track of inventories, assess needs, and compare products far more efficiently than they could using traditional business communications.

The Internet also has important uses within the financial community. Many banks and stockbrokers offer their customers software to make and track investments from their computer. Consumers can use similar software to pay many types of bills. Individuals can also file tax returns and pay taxes over the Internet. Economic transactions over the Internet use encryption technology to protect the privacy and security of the users.

A popular type of Internet business is the online auction. Online auctions enable people to post descriptions of items they wish to sell, along with a suggested opening bid. Visitors to the auction site may place a bid on any posted item. Consumer auction sites offer almost every imaginable type of item. But most forbid the sale of dangerous or illegal materials. Business auction sites, also called *trading exchanges,* have captured a large share of B2B transactions. Such sites may, for example, offer manufacturers the chance to bid on raw materials.

Push technology, also known as *Webcasting* or *Netcasting,* takes advantage of the ability of the Internet and the Web to deliver high-quality digital audio or video signals. Push technology enables producers to distribute their presentations to PC's and other devices capable of receiving and playing them.

Push technology programs have no fixed schedules. A producer can offer audio or video presentations to anyone who subscribes to them. The user might either download the entire video to his or her computer for later playback or play it in real time over the Internet. Real-time play is possible through a technology called *streaming.* Many radio stations stream their programming in real time so that people throughout the world may listen over the Web. Many also offer downloads of previous programming.

Television networks and movie producers often use push technology to promote their products and to present clips from programs and motion pictures. Some television producers have created programming specifi-

cally for the Web. Such programs are often called *Webisodes.*

Some television news organizations use the Web to post additional stories, constantly updating the news. They also offer extended versions of interviews and other features. Popular offerings include weather reports, global financial information, sports scores, and breaking news.

The Net is a popular showcase for short independent films. Many independent and amateur filmmakers create films using *digital video cameras,* which store video in digital format suitable for transmission over the Internet. They can then use special software to edit their films and to add professional-quality special effects.

Other uses. Yet another popular feature of the Net is *chat.* Using special software, users can gather in electronic "chat rooms" and send typed messages back and forth, discussing topics of common interest. The Internet also features many Web-based games with animation, sound effects, and music. Game players can challenge others in distant countries to tournaments.

The creation of personal Web pages is a particularly popular use of the Web. Individuals create and maintain these pages. Some people use their pages to share such information as personal interests or family history. Others use personal Web pages to promote particular ideas and theories. Most ISP's and online services provide space on a resource computer called a *server,* or *host,* for *hosting* (storing) Web pages for individuals. Many services include the use of this space within the subscription price. But some charge the individual separately for the use of server space.

Advertisers often place messages on frequently visited Web pages. Links join these messages electronically to the advertiser's own Web site. In effect, advertisers can invite Internet users to view commercials on their computer. Additionally, a user can supply the advertiser with his or her e-mail address to get further information, or such incentives as discount coupons.

How the Internet works

Computer networks enable computers to communicate and share information and resources. The simplest networks consist of a user's computer, known as the *client,* and a server. The client makes requests of the server, which, in turn, provides the requested resources, such as information or software. The Internet works in much the same way, on a far vaster scale. To connect to the Net, a user *logs on* by instructing his or her computer's communications software to contact the ISP or online service. To protect the user's security, this process usually requires a secret password.

The Internet was built around telephone connections that were, for the most part, the same as those used for voice communications. But the ever-increasing volume of Internet traffic, and the large size of video and sound files, require faster communications links. High-speed links, often called *broadband connections,* can deliver large amounts of information more quickly than traditional telephone lines can.

Among the most common broadband connections are (1) cable television connections, (2) fiber-optic telephone lines, (3) ISDN (integrated services digital network) and DSL (digital subscriber line), and (4) satellite

© Brad Trent

Racks of routers enable an online service to direct the queries of millions of customers to the correct Internet addresses.

connections. Cable television connections use the same cables that deliver television signals to carry Internet traffic. They require the use of a special cable modem. Fiber-optic telephone lines employ thin, high-capacity fibers to transmit vast amounts of information as patterns of light. ISDN and DSL use new technologies to increase the information-carrying capacity of traditional copper phone lines. Satellite connections use wireless communications with orbiting satellites. They enable people to use the Internet even in locations with no land-based communications lines.

Once connected to the ISP or online service, the user has several options. The user's communications software alone may provide access to such functions as e-mail and newsgroups. Most such software also includes a simple word processing program that enables a user to compose, revise, or read messages. A piece of software known as a *browser* enables a user to gain access to millions of Web sites. Each site has a separate electronic address, known as a *uniform resource locator* (URL). Many search engines and other programs throughout the Internet maintain and constantly update directories of addresses.

The addresses themselves are organized into various *top level domains* (major categories). In a URL, the top level domain takes the form of an extension of two or

more letters, such as *.ca* for *Canada*, *.com* for *commercial*, *.edu* for *educational*, or *.museum* for *museum*. An organization called the Internet Corporation for Assigned Names and Numbers (ICANN) coordinates the assignment of top level domains. In the United States, a *domain name* includes a top level domain and a *second level domain*. In the domain name *worldbook.com*, for example, *worldbook* is the second level domain.

By typing an address, or by clicking on a link, a user transmits a request through the ISP or online service and onto the larger Internet. When the request arrives at the desired destination, the server responds by sending the user the requested information. This information is often in the form of a starting page called a *home page*, which often resembles the table of contents of a book or magazine. From a home page, the user can search for further information by using links to other pages within the same Web site or to other Web sites.

Most browsers include systems for *bookmarking* (recording) the addresses of favorite or frequently visited sites. A user who has bookmarked a site simply clicks on the appropriate bookmark to visit the site again.

Many individuals maintain personal Web sites under domain names that include their own names. Several companies register domain names. Many ISP's and online services also register domain names for their customers for an added charge.

Many files, especially illustration, motion-picture, and sound files, travel over the Internet in compressed form. One compression technique stores data that represent a less precise version of an image or sound than the original file does. Another technique saves space by removing image or sound data that are repeated, then merging all the repeated sections together into a separate file. When the original file is decompressed, the repeated sections return to their proper places.

Concerns about use of the Internet

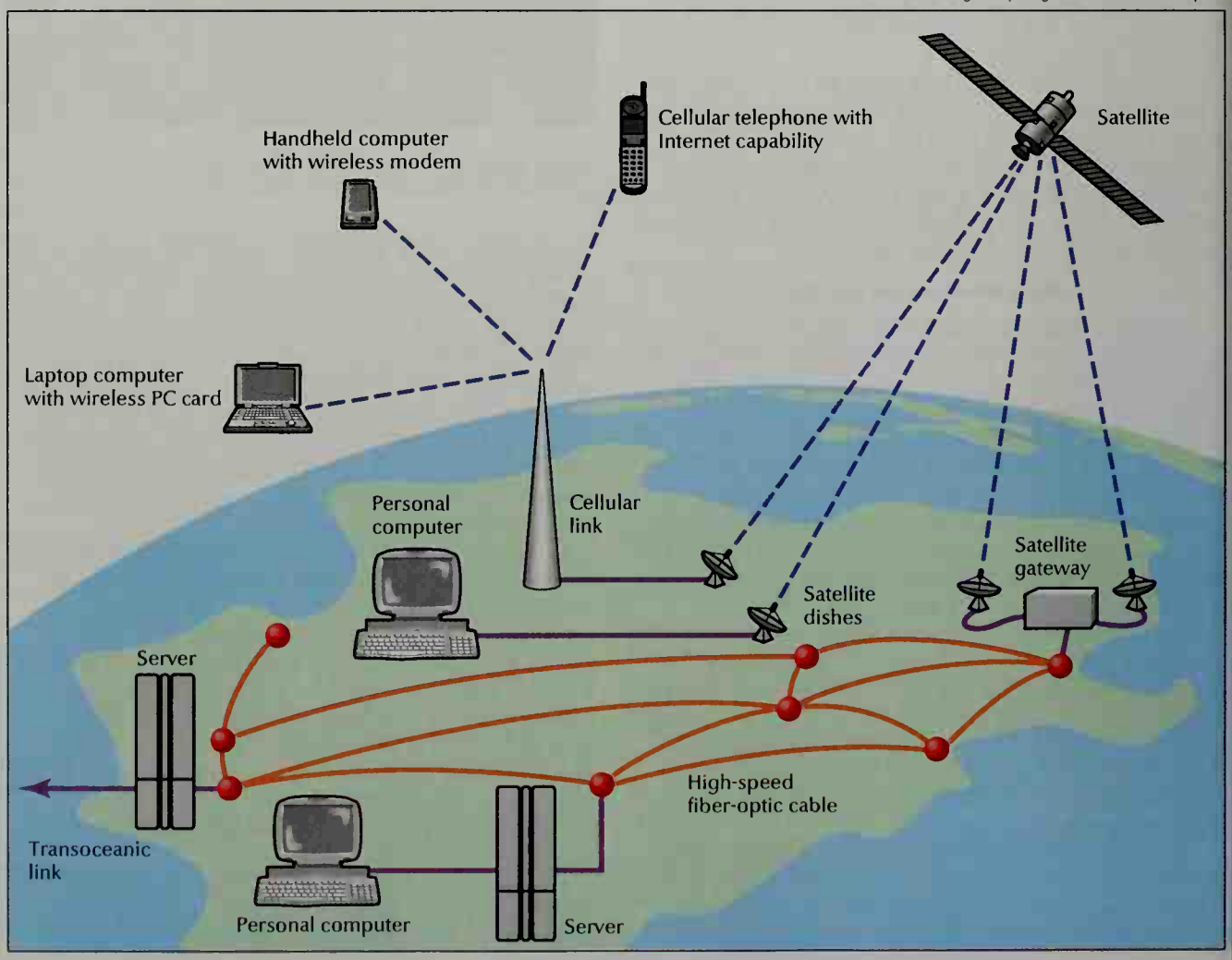
The Internet and the Web have revealed only a fraction of their potential as tools for education, research, communications, news, and entertainment. Most people believe that the benefits of the Internet far outweigh its challenges. However, some people have serious concerns over the use of the Internet.

Concerns about material. Among concerns over use of the Internet are doubts about the accuracy and appropriateness of the material available on the Net. Much information posted on the Internet may be mis-

How the Internet works

A number of different types of equipment enable people to gain access to the Internet. High-speed communication lines, wireless transmitters, and satellites may all play a part in a single exchange of information between two computers via the Internet.

WORLD BOOK diagram by Greg Maxson, Precision Graphics



leading, inaccurate, or even fraudulent. Many teachers teach their students how to evaluate the information they find on the Internet and identify reputable sources.

Many parents worry about violent or pornographic material available on the Net. Criminals may lurk in chat rooms, seeking to arrange face-to-face meetings with unsuspecting victims. Special programs known as *parental control software,* or *Internet filters,* can help parents restrict access to sites that may be unsuitable for children. In the United States, the Children's Internet Protection Act requires the installation of such filters in public schools that use federal funds to provide students with access to the Internet.

Security is an important concern for those who use the Internet. Mischievous programmers known as *hackers* often try to break into large computer systems. Some damage databases stored in these systems or attempt to steal information or electronic funds. Others may seek access to personal financial information. Many people feel concerned about the security and confidentiality of credit card numbers used to make purchases over the Internet. To protect themselves and their services from unwanted intruders, many ISP's and online services, corporations, and even individuals erect software and hardware barriers called *firewalls.* Such barriers seal off a server or other computer from intrusion.

Software itself can become a danger on the Internet. Programs known as *viruses, e-mail bombs, Trojan horses,* and *worms* can spread quickly across the Internet and cause damage to data on systems that receive them. Many companies produce software designed to protect users from such destructive programs. Most publishers of virus protection software update their programs when new types of viruses are detected. Customers can often download these updates over the Internet.

Legal issues. The distribution of e-books, digital music, and digital video poses important legal questions, particularly because digital files can be so easily *pirated*—that is, copied and distributed without permission or payment. Web users can e-mail copies of such files anywhere. Unauthorized Web sites offer pirated e-books, recordings, or videos. Some Internet companies provide sites where people can share digital music files. At first, sharing was free. But the traditional music industry claimed that the practice was illegal, and several distributors participated in lawsuits against the companies. As a result, these companies have begun to charge customers for downloads and pay fees to music publishers.

Internet availability. As the Internet and Web have become more popular and powerful, concern has grown about equality of access to their resources. Computers are costly, as are ISP and online service subscriptions. To ensure more equal access to the Net, many public libraries and schools provide Internet-capable computers for individual use. In many cities around the world, establishments known as *Internet cafes* offer people the use of Internet-ready computers for a fee based on time of use. Such establishments are especially popular in areas of the world where many people do not have computers or even telephones.

History of the Internet

Early development. The Internet began to take shape in the late 1960's. The United States Department of Defense was concerned at the time about the possibility of devastating nuclear warfare. It began investigating means of linking computer installations together so that their ability to communicate might withstand a war. Through its Advanced Research Projects Agency (ARPA), the Defense Department initiated *ARPANet,* a network of university and military computers.

The network's operating *protocols* (rules) laid the groundwork for relatively fast and error-free computer-to-computer communications. Other networks adopted these protocols, which in turn evolved as new computer and communications technologies became available.

Throughout the 1970's, ARPANet grew at a slow but steady pace. Computers in other countries began to join the network. Other networks came into existence as well. These included Unix to Unix Copy (UUCP), which was established to serve users of the UNIX operating system, and USENET (user network), a medium for posting text-based articles on a variety of subjects.

By 1981, just over 200 computers were connected to ARPANet. The U.S. military then divided the network into two organizations—ARPANet and a purely military network. During the 1980's, ARPANet was absorbed by NSFNET, a more advanced network developed by the National Science Foundation, an independent agency of the federal government. Soon, the collection of networks became known simply as the Internet.

One of the reasons for the slow growth of the early Internet was the difficulty of using the network. To access its information, users had to master a number of complex series of programming commands that required either memorization or frequent reference to special manuals.

The World Wide Web. The Internet's breakthrough to mass popularity occurred in 1991 with the arrival of the World Wide Web. The Web was developed by Tim Berners-Lee, a British computer scientist at the European Organization for Nuclear Research (CERN). One feature that helped popularize the Web was its ability to deliver multimedia.

The programming language that the Web used, called *hypertext markup language* (HTML), made it far easier to link information from computers throughout the world. This development effectively created an inter-

CERN

Tim Berners-Lee, a British computer scientist working at CERN, a European scientific research center, developed the World Wide Web. The Web opened the Internet to multimedia.

active index that enabled users to jump easily from the resources of one computer to another, effortlessly following an information trail around the world. The arrival of browsers in 1993 further simplified use of the Web and the Internet, and brought about staggering growth.

In the 1990's, many businesses were created on the Internet. Some were considered among the most valuable businesses in the world. But their values often rested in their potential, or the excitement people felt about this new way of doing business, and few actually made a profit. By 2000, many of these companies had gone out of business. Companies that operated traditional retail businesses in addition to ones on the Internet were, on the whole, more successful.

New technologies continue to increase the importance of the Internet. Handheld computers and Internet-capable cellular telephones take advantage of satellite communications to enable people to access the Internet from any location. Dedicated devices often called *Internet appliances* or *network computers* provide e-mail and Web browsing ability to people who do not require the greater capabilities of a PC. Manufacturers increasingly add computer features to television sets, and many of these sets provide Internet capabilities.

The Web has moved rapidly from inception to global acceptance. Most computer experts expect the Web to continue its rapid growth. New technologies will aid its growth by adding such features as spoken-word commands, instantaneous translation, and increased availability of historical and archival material. Keith Ferrell

Related articles in *World Book* include:

Auction
Berners-Lee, Tim
Communication (The development of the Internet)
Computer (Computer networks)
Distance learning
E-commerce
Electronic publishing
Etiquette (Internet etiquette)
Information retrieval
Medicine (Computers and electronic communication)
Online service
Web site
World Wide Web

Outline

I. Uses of the Internet
- A. Communications
- B. Research
- C. Publishing
- D. Business transactions
- E. Push technology
- F. Other uses

II. How the Internet works

III. Concerns about use of the Internet
- A. Concerns about material
- B. Security
- C. Legal issues
- D. Internet availability

IV. History of the Internet

Questions

What are some legal issues raised by the distribution of digital files over the Internet?
What is *multimedia?*
What is a *Web site?* A *Web page?*
How does the Internet aid television and movie producers?
How did the introduction of the World Wide Web increase the popularity of the Internet?
What are some ways in which the Internet benefits society?
How do *links* make it easy to move from Web page to Web page?
What is a *server?*
What role do telephone lines play in the Internet?
What is *e-commerce?*

Inter-Parliamentary Union is an organization made up of representatives of parliaments throughout the world. Its objectives are to promote representative institutions and to work for international peace and cooperation. National inter-parliamentary groups from more than 100 countries, including the United States and Canada, are active in the union. The union holds two regular conferences each year and organizes special meetings to discuss specific issues.

The Inter-Parliamentary Union was founded in 1889. It has its headquarters in Geneva, Switzerland.

Critically reviewed by the Inter-Parliamentary Union

Interpol is an intergovernmental organization of police authorities from about 175 countries. Its official name is the International Criminal Police Organization. Interpol works to ensure and promote cooperation and mutual assistance among member police authorities. Members must act within the limits of the laws of their respective countries. Interpol is prohibited by its own constitution from investigating or interfering with military, political, racial, or religious affairs. Interpol was founded in 1923. Its headquarters are in Lyon, France.

Critically reviewed by the International Criminal Police Organization

Interstate commerce includes all commercial transactions that cross from one state to another in the United States. A trip, the shipment of goods, or sending a message may be interstate commerce. In its broadest sense, however, interstate commerce has come to mean all dealings and affairs that concern more than one state and have a real and substantial relation to the national interest. Commerce carried on within the borders of only one state is called *intrastate commerce.*

Throughout U.S. history, there have been many disputes, laws, and court decisions concerning the regulation of interstate commerce. A clause in Article I of the U.S. Constitution, called the "commerce clause," gives Congress the power to "regulate commerce with foreign nations and among the several states. ..." Interpretations of this language by the Supreme Court of the United States have given Congress broad regulatory powers. On the basis of the commerce clause, the federal government regulates many economic activities. These include child labor, minimum wages and hours, manufacturing, transportation, communication, and racial discrimination in the use of public accommodations. The Departments of Justice and Labor and several federal agencies enforce interstate commerce laws.

In some cases, the states may pass local laws affecting interstate commerce. State regulations are permissible if they do not conflict with federal laws and do not create an excessive burden on interstate commerce.

The commerce clause corrected a weakness of the Articles of Confederation, under which the first government of the United States operated. The Articles, adopted in 1781, lacked power to regulate commerce. Each state set up various taxes, tariffs, and trade restrictions that would give it an advantage over the other states. Delegates to the Constitutional Convention of 1787 were convinced that the national government needed some central control over commerce. The Constitution they wrote provided that the United States Congress would have sole authority over interstate and foreign commerce. See Articles of Confederation; Constitution of the United States.

Although the Constitution gives Congress the power to regulate interstate commerce, it does not define the word *commerce*. As early as 1824, the Supreme Court gave a broad interpretation to the commerce clause. In the case of *Gibbons v. Ogden,* the court stated that commerce was not limited "to traffic, to buying and selling, or the interchange of commodities ... but it is something more. ... It describes the commercial intercourse between nations, and parts of nations, in all its branches, and is regulated by prescribing rules for carrying on that intercourse." The Supreme Court has used this definition to uphold the constitutionality of many interstate commerce laws. See **Gibbons v. Ogden**.

The Interstate Commerce Act of 1887 marked the beginning of extensive federal government regulation of interstate commerce. The act was designed to prevent discrimination and abuses by railroads.

The first railroads had begun to operate in the United States during the early 1800's. By the mid-1800's, a number of railroad companies had grown strong by merging with other railroad firms and by adding new routes. These railroads provided faster, cheaper, and more efficient service than other systems of transportation. People and industries increasingly began to rely on railroads and greatly reduced the use of highways, rivers, and canals for commerce.

During the 1860's, many railroads began to abuse their favored position. Some railroads that had a monopoly on the service to a particular town charged unfairly high rates for that service. Rival railroads sometimes agreed among themselves to charge comparable rates that far exceeded the costs of certain services. Higher rates were sometimes charged for shorter hauls than for longer hauls over the same route. Many railroads charged lower rates to shippers who gave them large amounts of business than to farmers and other small shippers even though the service was similar. Public demands for an end to the unfair business practices of railroads steadily increased.

In 1887, Congress passed the Act to Regulate Commerce. This act limited both the use of different rates for the same service and any agreements that set standard prices in the industry. The act, which became known as the Interstate Commerce Act, also created the Interstate Commerce Commission (ICC) to enforce the law. The ICC was the first federal regulatory agency and served as a model for future agencies. The ICC's authority was later extended to most forms of interstate transportation on land and water.

Other regulatory commissions. During the late 1800's, many large-scale manufacturing and mining firms began to abuse their power over consumers. Like the railroads, the firms often eliminated competition or charged unfairly high prices. In 1890, Congress passed the Sherman Antitrust Act. This act became the first of a series of federal measures designed to combat monopoly in all types of industries. Another important development occurred in 1914, when Congress established the Federal Trade Commission to protect free and fair competition in the economy.

Congress has set up many other regulatory agencies. The Federal Aviation Administration regulates air traffic. The Federal Communications Commission regulates communications. Other agencies regulate such activities as stock and commodity trading and labor relations.

Interstate commerce today. Before 1937, most matters regulated as interstate commerce included (1) the transportation of people and goods across state lines; (2) the interstate transmission of messages and electric power; and (3) the buying and selling of goods intended for shipment or use in other states. The matter regulated had to be *in* interstate commerce; it could not precede or follow interstate commerce. For example, the Supreme Court's 1935 decision in *Schechter v. United States* held that Congress could not regulate the wages and hours of workers who prepared for local use goods brought in from other states.

In 1937, the Supreme Court returned to a broader interpretation of the words "commerce among the states." *National Labor Relations Board v. Jones and Laughlin Steel Corporation* was the first of a series of cases giving Congress wide regulatory powers. In that case, the court held that local activities of labor unions bear "a close relationship with interstate commerce," and therefore may *affect* commerce. From the time the court made its decision, the matter regulated no longer had to be in the flow of commerce among the states.

Since 1937, a variety of laws concerning matters that might affect commerce have been passed by Congress and upheld by the Supreme Court. These include laws regulating wages and hours, child labor, discrimination against shippers, fraudulent security transactions, professional football, and deceptive selling practices.

In the 1960's and 1970's, an increasing number of people charged that the regulation of interstate commerce had brought about some unreasonably high or low transportation rates. The Civil Aeronautics Board, which regulated the fares, routes, and schedules of commercial airlines, was strongly criticized and later abolished. Other critics argued that the ICC's strict regulation of railroad rates made it difficult for the railroads to compete with trucks or barge lines.

As a result of these criticisms, Congress passed several *deregulation* laws during the late 1970's and early 1980's. These laws greatly reduced the powers of regulatory agencies in the airline, trucking, and railroad industries. For example, the Airline Deregulation Act of 1978 provided for the end of many federal controls over commercial airlines. John C. Spychalski

Related articles in *World Book* include:

Federal Aviation Administration
Federal Communications Commission
Federal Trade Commission
Interstate Commerce Commission
Schechter v. United States

Interstate Commerce Commission (ICC) was an independent agency of the United States government from 1887 to 1995. It enforced federal laws that dealt with the transportation of passengers and property by land and water across state lines. The commission regulated the rates and trade practices of companies that provided transportation between states by train, motor vehicles, and barges.

The commission worked to ensure that adequate services were available to the public. It also encouraged fair wages and good working conditions in the transportation industry. Rates were to be set fairly, with no unjust discrimination or competition. The commission worked with officials of the states to develop and pre-

serve the national transportation system.

Congress created the Interstate Commerce Commission in 1887. The original commission had authority only over railroads and had little power to enforce its rulings. It obtained powers to enforce its orders in 1906. Later, several laws expanded the commission's authority. In 1935, for example, it received authority over trucks and buses. It gained responsibility for shipping on inland waterways in 1940.

The commission lost its authority over passenger train services in 1970, when Congress created Amtrak. Amtrak is a semipublic corporation that operates intercity passenger trains. In 1976, the commission's powers were reduced again when a federal law gave railroads greater freedom from the commission in establishing freight rates and in other matters. A 1980 law further reduced the commission's control of the railroad industry. Legislation passed in 1980 and 1982 reduced its authority over the trucking and passenger bus industries.

In 1995, Congress further deregulated the rail, trucking, and bus industries and abolished the Interstate Commerce Commission. It transferred all remaining regulatory functions to the newly created Surface Transportation Board and to the Federal Highway Administration of the U.S. Department of Transportation.

Critically reviewed by the Surface Transportation Board

Interstellar medium is all the ordinary matter between the stars in a galaxy. It includes gases and tiny solid particles known as *interstellar dust.*

The average density of the gas in our home galaxy, the Milky Way, is only about one particle per cubic centimeter. This is much less dense than the best vacuum that can be achieved in a laboratory. Most of this gas consists of molecules and single atoms of hydrogen. The next most abundant element is helium, and other elements are much less plentiful.

Most of the dust consists of glassy *silicate* particles and *graphitic* matter. A silicate is a mineral containing silicon, oxygen, and one or more metallic elements. Graphitic matter contains *graphite,* a form of carbon. The dust particles come in a range of sizes. The vast majority of them are millions of times smaller than the dust that would be found on a desk at home or school.

Like ordinary smoke, interstellar dust blocks out visible light. Thus, the Milky Way's interstellar medium first appeared to astronomers as oddly shaped dark patches in photographs taken in visible light. The patches appeared against the background "sea" of stars.

The interstellar medium is distributed unevenly within a galaxy. In the Milky Way and other spiral galaxies, the spiral arms have higher gas densities than the regions between the arms. Gigantic *supernova remnants,* masses of material thrown off by exploding stars, are filled with very hot, low-density gas.

Extremely hot stars heat the gas near them, so this gas often glows in beautiful colors. New stars form when cold, especially dense regions of the interstellar medium collapse due to their own gravity. Alyssa A. Goodman

Intervention is an act in which one nation interferes in the internal affairs of another nation. Intervention may occur through the use of force or economic power. An example was the demand by the United States in April 1898 that Spain withdraw its troops from Cuba, which was then in rebellion against Spanish rule.

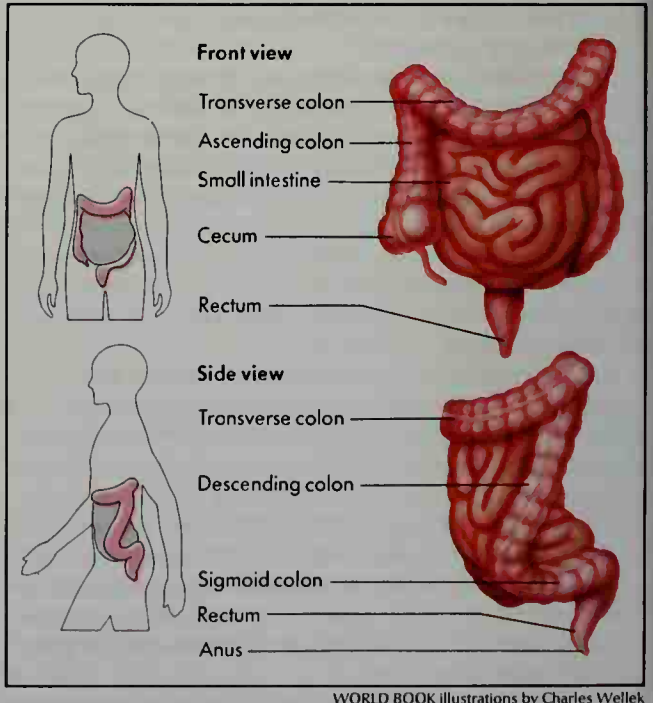
Most powerful nations have at some time intervened in the affairs of weaker neighbors. According to some international lawyers, a country has the right to intervene whenever it sees a threat to its own peace and safety or to the property and persons of its citizens. Some authorities justify such intervention as the prevention of useless bloodshed. Today, intervention is considered most defensible when such action takes place under the authority of a major international agreement or convention, such as the United Nations Charter. But there are still no universally accepted standards for intervention by a nation to defend what it considers its national interest. Robert J. Pranger

See also **Monroe Doctrine; United Nations.**

Intestine is the muscular tube in the body through which food and the products of digestion pass. It extends from the lower end of the stomach to the *anus,* the lower opening of the digestive tract. It is divided into two sections called the small intestine and the large intestine. The intestine is also called the *bowel.*

The small intestine is a narrower tube than the large intestine. It is about 22 feet (7 meters) long and empties into the large intestine. The small intestine carries on most of the digestive process. Digestive juices, or enzymes, secreted or manufactured by the walls of the small intestine, together with enzymes from the liver and pancreas, complete the digestion of foods.

The small intestine also is the main organ of absorption in the body. Digested food passes through tiny fingerlike projections in the wall of the small intestine. These projections, called *villi,* are lined with a single layer of cells and increase the absorbing surface of the walls of the small intestine. See **Human body** (picture: A magnified cross section). As food passes through the villi, some of it goes into tiny blood vessels in the villi



WORLD BOOK illustrations by Charles Wellek

The intestines make up a major part of the digestive system. Food is broken down and absorbed in the small intestine. The large intestine—which consists of the cecum, the colon, and the rectum—eliminates undigested wastes from the body.

and the rest passes into *lacteals* (lymph vessels). Digested food that passes into the lacteals is called *chyle.* Chyle travels through the *thoracic duct* to the neck where it is released into the blood.

The large intestine is about 5 feet (1.5 meters) long and is made up of the cecum; the ascending, transverse, descending, and sigmoid portions of the colon; and the rectum. The large intestine absorbs water and salts from the material that has not been digested as food, and eliminates wastes from the body. André Dubois

Related articles. See Human body (Trans-Vision three dimensional picture). See also:

Alimentary canal	Constipation	Hernia
Appendicitis	Crohn's disease	Indigestion
Catgut	Diarrhea	Inflammatory bowel disease
Colitis	Digestive system	Typhoid fever
Colon	Elimination	Ulcer
Colon cancer	Giardiasis	
Colostomy		

Intolerable Acts were five British laws to which the American colonists strongly objected. The acts were passed by the British Parliament early in 1774. Four of these laws were intended to punish the people of Massachusetts for destroying the tea that they threw into Boston Harbor in December 1773, and to strengthen British authority in Massachusetts (see Boston Tea Party). The Intolerable Acts were also known as the *Coercive Acts.*

The first act, the Boston Port Act, closed the port of Boston. According to this law, the port would be reopened only after Bostonians paid for the tea and showed a proper respect for British authority.

The second act provided that any officer or soldier of the British government who was arrested for murder could be sent to England for trial.

The third act, called the Massachusetts Government Act, changed the charter of Massachusetts. It provided for a council appointed by the Crown and prohibited town meetings without the governor's permission, except to elect officers. The fourth act required the colonists to *quarter* (feed and house) British soldiers.

Americans mistakenly believed that the fifth act, called the Quebec Act, was also intended as a punishment. This act extended the province of Quebec southward to the Ohio River, and granted freedom of worship to Roman Catholics in the province.

The Intolerable Acts were an important force in uniting Britain's 13 American Colonies. The British leaders who had intended merely to punish one colony found that they had practically driven all the colonies to war. John L. Bullion

See also Boston Port Act; Continental Congress; Revolutionary War in America (The Intolerable Acts).

Intoxication is the condition in which the body is poisoned by a toxin or by a narcotic, alcohol, or some other drug. The substance is absorbed into the blood and carried to all parts of the body. See Narcotic; Toxin.

The effects of intoxication depend on the nature of the substance. Intoxication caused by toxins and dangerous drugs may result in headache, dizziness, vomiting, stomach pains, and sometimes coma and collapse. Intoxication caused by narcotics or alcohol has powerful effects on the central nervous system, such as slurring of speech and loss of short-term memory. Extreme cases of intoxication may cause death. Research indicates that genetic factors influence the effects in intoxication caused by drugs.

Intoxication may also be caused by some harmful material produced by the body itself which is not adequately eliminated in the urine or *stools* (solid body wastes). A condition called *intestinal autointoxication,* for example, is due to the accumulation of intestinal poisons in the blood. A body disturbance causing intoxication can be dangerous and doctors try to correct the cause. Kenneth Blum

See also Alcoholism; Breath testing; Driving while intoxicated; Drug abuse.

Intramural sports, *IHN truh MYUR uhl,* provide recreation and athletic competition among students who attend the same school. The word *intramural* means *within the walls.* Most colleges and universities, and many elementary schools and junior and senior high schools, have extensive intramural programs. These programs appeal to large numbers of students who do not participate in intercollegiate or interscholastic sports. Many companies, prisons, and military bases also offer intramural programs.

Intramural activities range from team sports, including basketball and softball, to such individual sports as jogging and tennis. At the college level, teams are formed by dormitories, fraternities, sororities, and independent groups. Colleges offer separate programs for men and women as well as *co-recreational programs,* in which men and women participate together. The National Intramural Sports Council and the National Intramural-Recreational Sports Association promote the quality and growth of intramural sports in the United States. R. Wayne Edwards

Intrauterine device. See Birth control (Methods of birth control).

Intravenous injection, *IHN truh VEE nuhs,* is given into the blood inside a vein. Doctors use intravenous injections to put needed substances into the bloodstream of patients. The substances, in liquid form, are fed through a hypodermic needle placed inside a vein close to the skin.

When doctors give whole blood, blood plasma, or blood cells by this method, they call it a *transfusion.* Patients who cannot eat or drink sometimes can be kept alive by intravenous feeding of solutions containing sugar, vitamins, and minerals. Many lifesaving medicines are given to patients intravenously. Edwin S. Munson

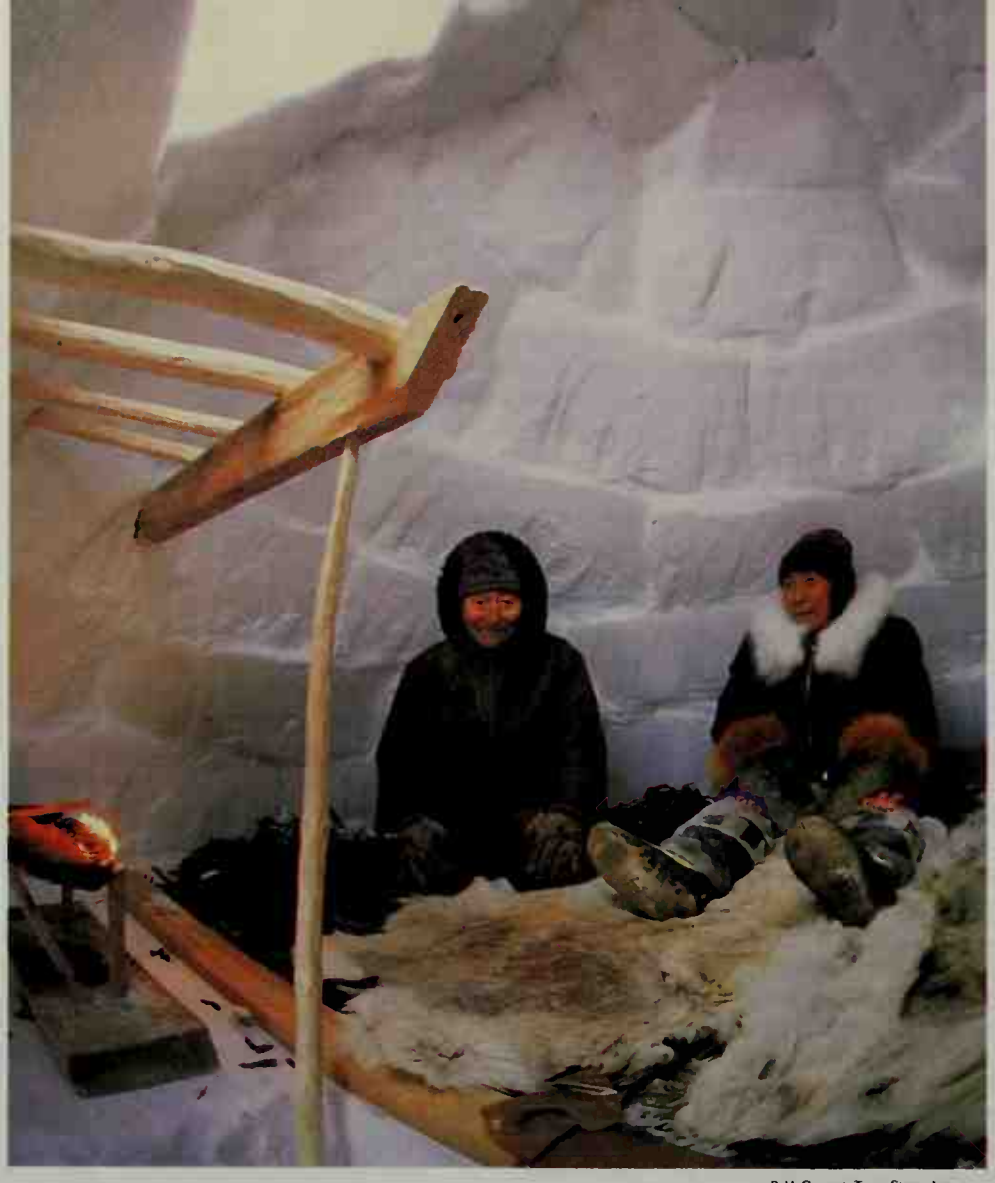
See also Hypodermic injection.

Introvert, *IHN truh vurt,* when used nontechnically, usually means a shy, unsociable person. Swiss psychiatrist and psychologist Carl G. Jung defined *introversion* as a turning of mental interests away from people and events of the outer world to the inner world of one's own thoughts. He believed that in a normal person, introversion is balanced by extroversion (see Extrovert). But in an introvert, the tendency toward introversion is greater than toward extroversion.

Jung thought that if the tendency toward introversion became extreme, it would dominate a person's unconscious mental life and create a conflict between the two tendencies. This conflict would result in a *neurosis,* which is a kind of mental illness. Paula J. Clayton

See also Jung, Carl Gustav.

Intrusive rock. See Igneous rock.



P. H. Cornut, Tony Stone Images

The Inuit live farther north than any other people in the world. They have developed many ways to survive in their harsh Arctic climate. For example, a traditional type of Inuit house, such as the one pictured, is built of snow. The Inuit also depend on animal products for many necessities. This photograph shows Inuit rugs and clothing made from animal skins and a fire fueled by animal blubber.

Inuit

Inuit, *IHN yoo iht,* are a people who live in and near the Arctic. Their homeland stretches from the northeastern tip of Russia across Alaska and northern Canada to Greenland. Many Inuit live farther north than any other people in the world.

In this article, the word *Inuit* refers to the people formerly called Eskimos. The term *Eskimo* comes from a Native American word that may have meant *eater of raw meat, netter of snowshoes,* or *speaker of a foreign language.* Many Inuit consider this term insulting. They prefer the name Inuit, which means *the people* or *real people,* and comes from a language called Inuit-Inupiaq. The singular of Inuit is *Inuk,* which means *person.* Dialects of the Inuit-Inupiaq language are spoken by the Inuit in Canada, Greenland, and northern Alaska.

Another group of Arctic people, the Yuit, are often called Inuit as well. Their culture resembles that of other Inuit, but they speak a different language called Yupik. The Yuit live in western and southern Alaska and in Siberia in Russia.

Inuit culture developed more than 1,000 years ago in what is now the Bering Sea region of Alaska and Siberia. Most Inuit have always lived near the sea, which has provided much of their food. The first Inuit hunted bowhead whales and other mammals. As the Inuit spread eastward, they modified their way of life to suit the Arctic environments they encountered. They caught fish and hunted seals, walruses, and whales. On land, they hunted a type of deer called *caribou,* musk oxen, polar bears, and many smaller animals. The Inuit used the skins of these animals to make clothes and tents. They crafted tools and weapons from the animals' bones, antlers, horns, and teeth. In summer, they traveled in boats covered with animal skin and, in winter, on sleds pulled by dog teams. Most Inuit lived in tents in the summer and in large sod houses during winter. When traveling in search of game in winter, they built snowhouses as temporary shelters.

The Inuit way of life began to change in the 1800's. At that time, European whalers and traders began arriving in the Arctic in large numbers. The Inuit eventually adopted many aspects of European culture and permanently altered their traditional way of life.

Today, there are more than 100,000 Inuit in Russia, Alaska, Canada, and Greenland. Most live in towns or

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small settlements scattered along the Arctic coast. The Inuit retain a considerable knowledge of their ancient culture. Many Inuit still spend much of their time in traditional activities, such as hunting and fishing.

The land of the Inuit

The Inuit live in one of the coldest and harshest regions of the world. Most kinds of plants and animals cannot live as far north as the Inuit do.

Inuit lands include the northeastern tip of Siberia, the islands of the Bering Sea, and the coastal regions of mainland Alaska. They also include the north coast and islands of the Canadian Arctic and most of the west coast and part of the east coast of Greenland. The region is often called the Land of the Midnight Sun because the sun shines all day and all night for part of each summer. During part of each winter, however, some areas are continuously dark. See Midnight sun.

Climate. Most of the Far North has long, cold winters and short, cool summers. Average temperatures in the region rise above freezing for only two or three months each year. During the coldest months, temperatures average between −20 and −30 °F (−29 and −34 °C). Annual snowfall averages between 15 and 90 inches (38 and 229 centimeters). Little of the snow melts until spring, and winter storms of wind-driven snow can force people to remain inside for days at a time. However, because snow contains much less water than rain, average *precipitation* (rain, melted snow, and other forms of moisture) totals only about 6 to 10 inches (15 to 25 centimeters) per year. Such scarce precipitation makes the Arctic technically a desert.

Thick sheets of ice cover parts of some northern Canadian islands and most of Greenland throughout the year. Rivers, lakes, and the sea itself remain frozen for much of the year. Even in summer, large pieces of ice float in the sea. When the wind blows toward the shore, it often piles this ice on beaches.

Plants and animals. The land area of the Arctic consists mainly of huge treeless plains called *tundra*. In most places, only the top 1 to 10 feet (30 to 300 centimeters) of ground thaws in summer. Below that level, the ground remains permanently frozen in a condition called *permafrost*. During the summer, melted ice or snow creates many ponds, small lakes, and swamps.

The Arctic has no forests. Tundra vegetation consists of low shrubs, mosses, grasslike plants called *sedges*, and tiny flowering plants. Rootless, plantlike organisms known as *lichens* grow on many rocks. For a short time each summer, colorful flowers bloom in great abundance in the tundra.

Seals, walruses, whales, and polar bears live in the sea, on the sea ice, and along the Arctic shores. The tundra supports populations of caribou, musk oxen, wolves, foxes, and hares. Many of these animals migrate south annually and are available to Inuit hunters for only a few months each year. Numerous ducks and geese summer in the Arctic, where they build their nests and raise their young. Some birds, such as the ptarmigan (pronounced *TAHR muh guhn*), are year-round residents. Fish include Arctic char, Arctic cod, lake trout, salmon, and whitefish.

Traditional way of life

From the earliest beginnings of their culture, the Inuit lived a way of life different from that of most other people. The Inuit had little contact with other cultures for most of their history. Some occasionally met with other northern peoples that lived south of Inuit country. Such meetings were often hostile. Over time, however, strong

Inuit lands

The Inuit have lived in the Arctic for thousands of years. Some areas formerly occupied by the Inuit are no longer inhabited. But most of the groups named on this map have inhabited the areas for centuries. Most groups are named for the areas in which they live. In Russia and parts of Alaska, the Inuit are called Yuit.

Bryan & Cherry Alexander

An Inuit family in Canada relaxes inside a hunting lodge. Traditionally, the Inuit lived in small groups that sometimes consisted of only one family. Each member of a family had to help in the activities that ensured the group's survival.

trade relationships developed between these peoples.

The Inuit have always lived in small groups scattered over a huge region. Many differences developed among the cultures of the widespread Inuit groups. These differences make it impossible to describe a general way of life for all Inuit. The following sections chiefly discuss the traditional way of life of Canadian Inuit before the arrival of Europeans. Inuit people no longer follow many of these ways.

Group life. The Inuit lived in groups that varied in size from a single family to several hundred people. The size of the groups depended on the amount of food available in different seasons. During the spring and fall in Alaska, the largest groups gathered where they could hunt migrating caribou. On the coast of Labrador, Inuit groups often formed large winter villages to share the food and other necessities provided by the killing of a bowhead whale. Many of these larger communities split up during the rest of the year. Small Inuit groups moved about the countryside in search of fish, seals, birds, and other game. These local groups were the most important social units for the Inuit.

In most regions, an Inuit household consisted of a married couple, their unmarried children, and the married sons or daughters and their families. Some households also included one or more parents or unmarried siblings of the couple. Inuit groups governed themselves by traditional rules of conduct rather than written laws. The most important rule was that each individual help in the day-to-day activities that ensured the group's survival.

When disputes arose, Inuit societies often settled them by contests of strength or some other peaceful means. Conflicts sometimes resulted in groups splitting off from one another. If an individual's conduct threatened the safety or harmony of a group, that person was banished. Banishment usually meant death, because an individual could not survive alone in the Arctic.

Food. The Inuit diet varied according to location and the seasons of the year. On the Alaskan coast and the coast of Labrador, the kill of a single bowhead whale provided tons of meat for an Inuit community. In other parts of Alaska, the fall caribou hunt supplied communities for the entire winter. Many Inuit obtained food from smaller animals, including hares and foxes.

The Inuit also caught fish in the sea, lakes, and rivers. They ate berries and other plant foods when they were available. Delicacies included such items as the skin of beluga whales and fat from the backs of caribou.

The Inuit often ate meat raw or frozen. When they cooked meat, they used pots made from a soft stone called soapstone. Soapstone lamps, which were fueled by blubber or oil from seals and whales, provided heat. Inuit cooks used a curved knife called the *ulu* (pronounced *OO loo*) to prepare much of their food. The ulu was made in the form of a half moon. It had a blade of slate or metal and a handle of bone, ivory, or wood. The Inuit ate from wooden plates and bowls, using forks made of bone. They drank from cups made of the horns of musk oxen.

Clothing. The Inuit made their clothing from the skins of animals. Styles varied from region to region, but in all regions men, women, and children wore the same general outfit. It consisted of a hooded jacket called a *parka,* trousers or leggings, socks, boots, and mittens. The Inuit often wore goggles of wood, bone, or ivory to reduce glare from the sun. The goggles had small holes or narrow slits through which to see.

The Inuit preferred caribou skin as a material for clothing. The skin was lightweight, and the inner hairs of the skin made it warm. Skins from seals, foxes, polar bears, and other animals served as substitutes for caribou. The Inuit often decorated their clothing with furs, beads, and good luck charms such as carvings or parts of animals.

The parka fit loosely over the head, neck, and shoulders. It hung in varying lengths from above the waist to below the knees. Women often carried young children in the backs or hoods of their parkas. Most Inuit wore two layers of clothing in winter: an inner suit with the fur next to the skin and an outer suit with the fur on the outside. The air between the two layers provided insula-

tion, and the fur allowed perspiration to evaporate. In warmer weather, the Inuit wore only the inner suit of caribou or a suit of sealskin. The Inuit used sealskin to make their tightly sewn boots.

Shelter. Most Inuit families had both a summer and a winter dwelling. During the summer months, almost all Inuit lived in tents framed with wood and covered with seal or caribou skins. Some tents had raised platforms at the rear where people slept.

To build a winter house, the Inuit first dug a large hole in the ground. The builders then piled rocks and sod around the outer boundary of the hole to form walls. Rafters of wood or whalebone topped the walls and were covered with sod. Often, the Inuit excavated a sod-covered entrance passage below the level of the house floor. This passage kept warm air inside the house and cold air outside. Cold air became warmer as it flowed through the passage, and it then rose into the house. The Inuit usually stored food in this entrance passage or in storage areas off of the passage. Inside the house, the Inuit built sleeping platforms that filled most of the rear section. They also constructed platforms to hold oil lamps that provided heat and light. In addition, Inuit in some regions built a kitchen area near the entrance passage.

People often imagine that the Inuit lived in snowhouses for much of the year. In fact, only the Inuit of central Canada and the northern Canadian Arctic islands lived in snowhouses all winter. Most Inuit built snowhouses only as temporary shelters when traveling.

Inuit builders could construct a snowhouse in about two hours. First, they cut blocks of hard snow using a *snow knife,* a long, straight knife made from whalebone. They then stacked the blocks in a continuous, circular row that wound upward in smaller and smaller circles to form a dome-shaped house.

The Inuit who used snowhouses as permanent winter dwellings built much more elaborate structures. They attached storage rooms to the snowhouse and excavated entrance passages similar to those in sod houses. Sometimes, a series of passages connected a group of snowhouses occupied by several families. The Inuit arranged the interiors of permanent winter snowhouses in much the same fashion as sod houses. These interiors included both sleeping platforms and lamp platforms.

Transportation. During winter months, most Inuit traveled on sleds. In summer, they walked over land and traveled by boat over water.

The Inuit made two basic types of sleds: plank sleds and frame sleds. The plank sled was mostly used in Canada and Greenland and looked like a long ladder. It consisted of two long runners with a series of crosspieces lashed between them. The Inuit preferred wood as the material to make plank sleds. In areas where wood was not available, the Inuit used whalebone and even frozen animal skins. Frame sleds, used often in Alaska and Siberia, had a basketlike frame built on the runners. The frame slanted upward from the front to the back of the sled. For both kinds of sleds, the Inuit fastened sled shoes of whalebone to the bottoms of the runners. These shoes were both durable and slippery.

Both types of sleds were pulled by dogs. The Inuit of Canada and Greenland usually hitched each dog to the sled by a separate line. In this kind of hitch, the dogs fanned out in front of the sled as they pulled it. The Inuit of Alaska and Siberia hitched their dogs in pairs along a central line.

The Inuit kept as many dogs as they could feed. Northern Canadian Inuit, who lived in a particularly harsh climate, usually had only 1 or 2 dogs. However, teams of 10 or more dogs were common in eastern Canada. During the summer, many Inuit used dogs to carry packs as they moved from place to place.

The Inuit used two types of boats: the *kayak* (pronounced *KY ak*) and the *umiak* (*OO mee ak*). The kayak resembled a canoe with a deck. It had a narrow body pointed at both ends. The body consisted of a carefully fitted wood frame covered with seal or caribou skin. Because the Inuit normally used kayaks for hunting, they fitted harpoon rests to the deck. Most kayaks carried only one person, who sat in a hole in the deck. Some carried two people and had two holes. The design of the kayak remains popular today. Modern boatbuilders commonly make fiberglass boats that copy the kayak's design.

To propel a kayak, the Inuit used either a long paddle

Bryan & Cherry Alexander

Building a snowhouse involves cutting blocks of hard snow and stacking them in a continuous coil. This coil winds upward in smaller and smaller circles to form a dome-shaped house.

Bryan & Cherry Alexander

Building a kayak begins with constructing a sturdy wooden frame, like the one above. Traditionally, the Inuit covered the frame with animal skin. Most kayaks carry only one person.

with a blade at each end or a short paddle with a single blade. A kayaker often wore a special waterproof jacket made from seal intestine. The boater fitted the edge of the jacket around the edge of the kayak opening and tied the jacket in front to form a waterproof seal. A person could tip over in a kayak, roll back up, and continue to float.

The umiak was a large open boat that usually carried 8 to 10 people. Like kayaks, umiaks consisted of a wooden frame covered with skin. The Inuit propelled these boats with single-bladed paddles. Umiaks were used for long-distance travel. The Inuit hauled their belongings in umiaks when they moved camp, and they used the boats for hunting walruses and whales.

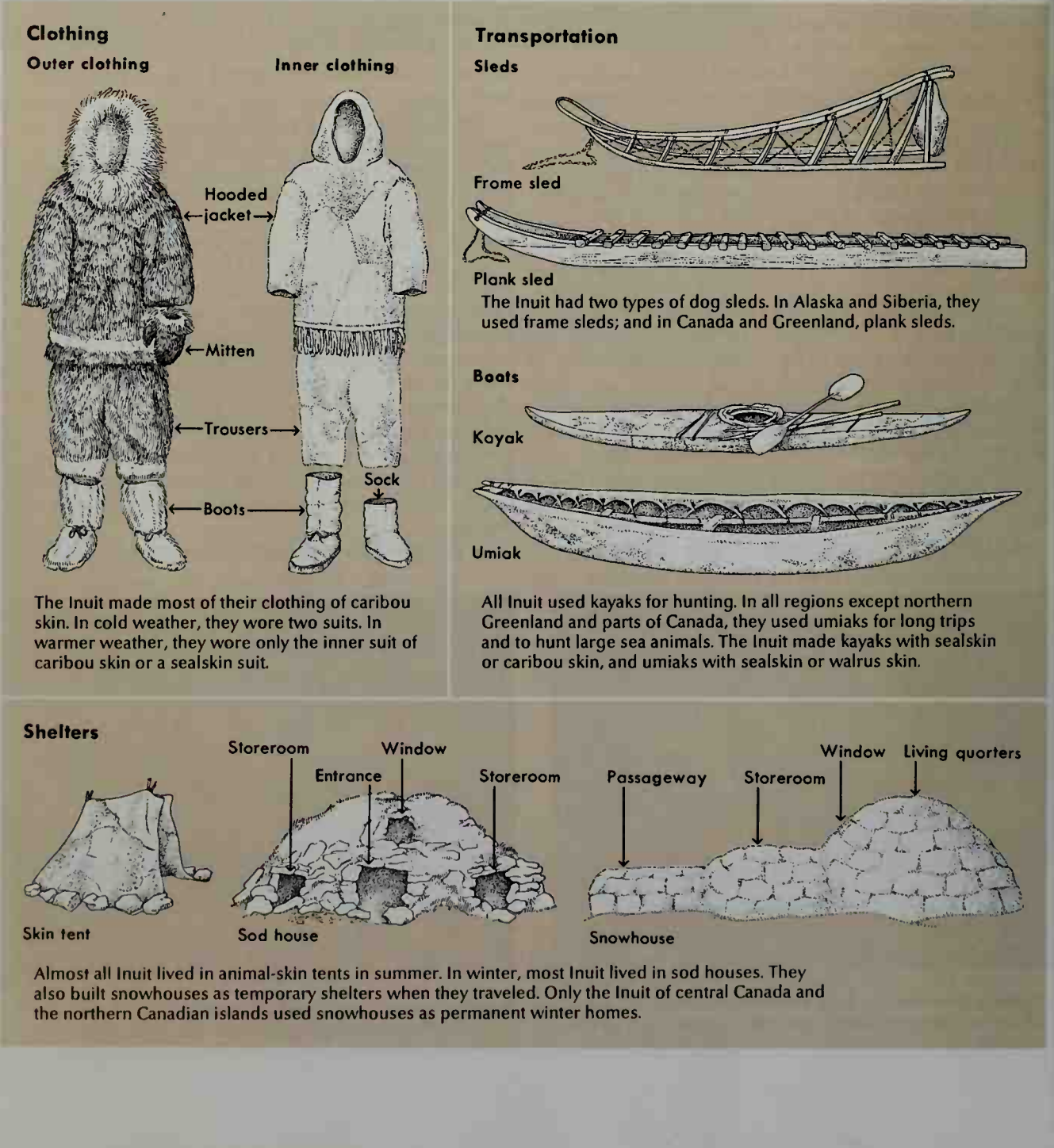
Hunting and fishing provided almost all of the Inuit's food and many of the raw materials for their tools, weapons, clothing, and shelter. The Inuit most commonly hunted seals and caribou, but they also killed whales, musk oxen, polar bears, hares, and birds.

The Inuit hunted seals by different methods in different seasons. In winter, they hunted at the breathing holes that the seals kept open in the ice. Hunters used long bone tools called probes to find the angle of the holes. They then waited by these holes and killed the seals when the animals surfaced to breathe. Some Inuit used tools that indicated when a seal was using a breathing hole. These tools often consisted of feathers or of a long, thin sliver of wood or bone called an *idlak* (*IHD lak*). A hunter would stick the indicator into the breathing hole. When a seal swam over to the hole, its breath would cause the indicator to vibrate. The Inuit would then kill the seal.

The Inuit killed seals with harpoons. They made harpoon heads from bone or ivory and tipped the heads

Traditional Inuit clothing, transportation, and shelter

WORLD BOOK illustrations by Marion Pahl



The Inuit made most of their clothing of caribou skin. In cold weather, they wore two suits. In warmer weather, they wore only the inner suit of caribou skin or a sealskin suit.

The Inuit had two types of dog sleds. In Alaska and Siberia, they used frame sleds; and in Canada and Greenland, plank sleds.

All Inuit used kayaks for hunting. In all regions except northern Greenland and parts of Canada, they used umiaks for long trips and to hunt large sea animals. The Inuit made kayaks with sealskin or caribou skin, and umiaks with sealskin or walrus skin.

Almost all Inuit lived in animal-skin tents in summer. In winter, most Inuit lived in sod houses. They also built snowhouses as temporary shelters when they traveled. Only the Inuit of central Canada and the northern Canadian islands used snowhouses as permanent winter homes.

with a stone or iron point. After the harpoon struck the animal, the harpoon head detached from its shaft. A sealskin line fastened to the head held the animal securely. When hunting through the ice, the Inuit held a handle at the end of the harpoon line.

In the spring, the Inuit hunted seals as the animals climbed out onto the ice. The hunters stalked seals slowly and carefully. Many hunters approached their prey by imitating the seals' movements as the animals awoke every minute or so to watch for danger. Other hunters stalked while hiding behind a movable hunting screen. The Inuit also hunted seals from the ice edge during spring and from kayaks during the open water months of summer. When hunting from the ice edge or from kayaks, the Inuit attached an inflated sealskin float to the other end of the harpoon line. This technique slowed the seal down and prevented the loss of the harpoon.

Inuit hunters used special bone plugs to close wounds in dead seals. These plugs held in the seal's blood, which was a common part of the Inuit diet. Hunters then pulled the seals home using large pins or handles of bone, wood, ivory, or antler.

Most Inuit hunted caribou by shooting them with arrows from small, stout bows. Hunters could also spear caribou from kayaks when the animals crossed lakes or rivers. The Inuit sometimes built rows of stone piles, which directed the caribou toward water crossings or other spots where hunters could spear them.

Inuit hunters also killed a variety of other animals. For example, many Inuit hunted whales by shooting them with *darts*—long, spearlike weapons that were tipped with poison. After shooting a whale, the Inuit would wait a few days for the animal to die and wash up on shore. Hunters trapped foxes in stone traps. These traps had small holes at the top through which the fox could not escape. A few Inuit caught polar bears in huge stone traps. Usually, a hunter's dogs surrounded the bear and kept it at bay until the hunter could kill it with a lance. In some other areas, the Inuit set snares to catch birds and hares. They also killed birds by throwing multipronged spears into the flocks.

The Inuit usually fished with a three-pronged spear called a *leister* (*LEES tuhr*). For much of the year, they fished through holes in the ice. In summer, the Inuit often fished in shallow streams. Sometimes, they placed lines of rocks in the streams to channel the fish toward them.

Religion. The Inuit believed that all people, animals, things, and forces of nature had spirits. The spirits of people and animals lived in another world after they died. Other spirits included those of the wind, the weather, the sun, and the moon. One of the most important spirits to many groups was a goddess who governed the sea. In some areas, she was called Sedna (*SEHD nuh*). She lived at the bottom of the ocean and controlled the seals, whales, and other sea mammals.

The Inuit followed special rules to please the spirits. They believed that if they ignored the rules, the spirits might punish them by causing sickness or other misfortune. In many communities, the wife of a hunter might offer a drink of water to an animal that had been killed. She would do this to satisfy its spirit. In Alaska, the Inuit saved the bladders of the seals they killed. They believed a seal's spirit rested within its bladder. In a special ceremony each year, the community returned the bladders to the sea to ensure good hunting in the year to come.

The death of an Inuk required certain observances. In many regions, the Inuit wrapped the body in skins and left it on the tundra, covered by an arrangement of stones. They often placed tools, weapons, and other items with the body for use in the otherworld.

Inuit communities usually had an individual who they believed had special powers to communicate with the spirit world. Such a person was called an *angekok* (*ANG guh kahk*) by the Inuit and a *shaman* by Europeans. These individuals could be either men or women. They healed the sick and tried to influence aspects of life over which people had little control. For example, they attempted to communicate with spirits to bring good

Bryan & Cherry Alexander

Catching fish in Inuit culture involves spearing the fish through holes in the ice. The Inuk fisherman shown above uses a three-pronged spear called a *leister* to catch his fish.

Michio Hoshino, Minden Pictures

Drying fish helps preserve the food for many months. The Inuit catch fish the year around. They often fish on frozen lakes in winter and in shallow streams during summer.

Norm Stelfox, Tony Stone Images

Skin drums are traditional instruments in Inuit music. The Inuit often use such drums to accompany dancers. These three drummers are Russian Inuit performing at a festival.

weather and to ensure a steady supply of game.

Recreation. The long Arctic winter was the time for storytelling and for passing the Inuit's unique traditions and mythology from one generation to the next. During winter, darkness and storms often kept people indoors for long periods. The Inuit performed traditional dances to the beat of a large skin drum. Other activities included song contests and tests of strength such as wrestling and tug-of-war.

One of the most popular Inuit games was the *blanket toss.* A dozen or more people held a round blanket made of walrus hides sewn together. When they all pulled the blanket tight, a person on the blanket was tossed into the air. The one being tossed tried to land on his or her feet and often did somersaults in the air. Another popular game was *ajegaq (AJ uh gahk),* in which a bone drilled with holes was tossed in the air and caught on a pin or spike. Inuit children played with toy bows and arrows, leather balls, and dolls made of wood, skins, or ivory.

Arts and crafts. The Inuit elaborately carved or decorated many of the objects they used every day. These objects included needle cases, snow goggles, combs, pins, and many other items made from antler, bone, or walrus ivory. The Inuit often carved pins and buttons into the forms of animals, such as seals and fish. They decorated clothing with some of these carvings and with the dyed skins of seals and the furs of foxes, wolves, and other animals.

Language. The Inuit included speakers of two related language groups. Most Inuit communities spoke dialects of the Inuit-Inupiaq language. These communities stretched from northwest Alaska to Greenland and southward into Hudson Bay and the Labrador coast. The other language, Yupik, was spoken in far eastern Siberia and along portions of the Alaskan coast.

The Inuit formed many of their words by adding one or more suffixes to a root word. Such words could have five or more syllables. For example, the Inuit word *igdlo* means *house,* while the word *igdlorssualiorpoq* means *he who builds a large house.* Inuit languages included numerous words that reflected their own way of life. For example, the Inuit used many terms for the seal. Different names depended upon the kind of seal, whether the animal was young or old, whether it was on land or in the water, and other circumstances.

AP/Wide World

Whale hunting has been a part of Inuit life since prehistoric times, and it remains an important activity among some Inuit today. In many areas, traditional techniques and tools for pursuing and killing whales have been replaced by such modern devices as motorboats and explosive harpoons. The International Whaling Commission (IWC) regulates the whaling to protect whale populations while allowing the Inuit to preserve a significant part of their cultural heritage.

History

Inuit origins. People have lived in the Arctic for thousands of years. The earliest Arctic peoples were not closely related to modern Inuit. They did not hunt large whales or use dogs to pull their sleds, and their tools and weapons were different from those of the Inuit.

Inuit culture developed in what is now the Bering Sea region about 1,000 years ago. The people there, who were of Asian origin, developed the technology to hunt huge bowhead whales. This culture spread eastward and is called the Thule *(THOO lee)* culture, after the place in northern Greenland where archaeologists first discovered it.

The Thule people, the ancestors of the Inuit, had reached present-day northern Alaska by A.D. 1000. There, they hunted bowhead whales along the shore during the whales' annual migrations. About A.D. 1000, Thule people began to spread eastward into what are now the Canadian Arctic and Greenland. They also moved southward into what are now Hudson Bay and the coast of Labrador. The Thule people displaced or absorbed earlier residents that lived in many of these regions. Archaeological evidence indicates that this expansion occurred rapidly. For example, scientists have found remarkably similar tools, weapons, and house types at Thule archaeological sites from the Bering Sea region in the west to Greenland in the east. Scientists think that warming climates may have been partly responsible for this rapid spread.

As the Thule people moved throughout this vast Arctic region, they modified their culture to suit the different environments they found. The Caribou Inuit of the west coast of Hudson Bay, for example, lived on caribou and fish. The Inuit of the Labrador coast hunted large whales.

In time, the Inuit in each region of the Arctic came to recognize themselves as distinct cultural groups with their own individual dialects. The members of these groups usually called themselves after the places where they lived. These names end with the suffix *-miut,* which means *the people of.* For example, *Aivilingmiut* means *the people of the village Aivilik.*

The arrival of Europeans. The first Europeans to meet Inuit people were Norse settlers in the northern part of what is now the island of Newfoundland in Canada. These settlers lived there for a short time in about A.D. 1000. Beginning in the 1500's, European whalers, fishing crews, and explorers met many Inuit along the coast of Labrador. The English explorer Martin Frobisher visited an Inuit village in the Baffin Islands in the 1570's. He and his party wrote descriptions of the village and made paintings and drawings of some Inuit people. Russians and other Europeans first met Alaskan Inuit in the 1700's. In the later 1700's, Moravian missionaries from what is now Germany traded with Labrador Inuit and converted many of them to Christianity.

In the mid-1800's, whalers began to hunt in the Arctic. Some Inuit worked for whalers and traded with them. The Inuit received firearms, ammunition, wood, iron, and other European goods. Unfortunately, European diseases often accompanied the whalers and traders. These diseases, which included smallpox and measles, completely wiped out some Inuit populations.

The Inuit way of life changed as a result of contact with Europeans. For example, many Inuit began trapping animals only for their furs, which they traded to Europeans for rifles and other goods. Because of the trapping, many animals the Inuit hunted became scarce. This scarcity, in turn, made the Inuit more dependent upon European goods and permanently altered their traditional way of life. Nevertheless, many Inuit continued to follow their traditional ways well into the 1800's.

New ways of life began for most Inuit in the early and middle 1900's. During that time, the impact of European societies on the Inuit increased greatly. The industrialized cultures of Europe were extremely different from traditional Inuit societies, and many Inuit had difficulty adopting European lifestyles. The Inuit way of life changed in different ways in Russia, Alaska, Canada, and Greenland.

In Russia, the Communist government of the Soviet

Joe Rychetnik, Van Cleve Photography

Inuit communities changed greatly in the 1900's. Wooden homes largely replaced sod houses, snowhouses, and tents. The Inuit also modified some of their traditional ways. For example, many began to use snowmobiles instead of dog teams to pull their sleds.

Union took control of all Inuit communities during the 1920's. Russia was part of the Soviet Union from 1922 until 1991, when the Soviet Union was dissolved. The Soviet Communists provided improved health care, housing, and education for the Inuit. However, they also forcibly relocated many Inuit groups from their traditional lands to other areas. The Inuit were grouped with other Siberian peoples into economic units called *collectives*. The purpose of the collectives was to produce goods for sale throughout the country. Since the Inuit could no longer hunt sea mammals for food, they began to sell walrus tusks and such handicrafts as bone and soapstone carvings.

In Alaska, hunting with rifles and widespread trapping greatly reduced the quantity of game animals by the late 1800's. As a result, many of the Inuit became unable to survive independently. The United States government brought reindeer from Siberia in an attempt to start a reindeer herding industry. However, the industry failed. The Inuit of Alaska became United States citizens in 1924.

During World War II (1939-1945), many Inuit worked at U.S. military bases in Alaska. After the war, some Inuit found part-time work in commercial fishing, construction, or other businesses run by the rapidly growing white population. But most Inuit could not find jobs. The U.S. government established programs to improve living conditions of the Inuit, but many of them still lived in poverty.

© Monatiuk/Eastcott from Woodfin Camp, Inc.

Inuit children listen to a story at a school in the Northwest Territories in Canada. Educational opportunities have increased greatly for the Inuit people since the mid-1900's.

Ken Graham

An Inuk technician uses a computer to regulate activity in a lead and zinc mine in Alaska. Mining and petroleum industries provide jobs for many of Alaska's Inuit people.

In Canada, the Inuit way of life changed little until the 1950's. At that time, the fur trade declined and the number of caribou decreased sharply after the animals had been hunted with rifles for many years. These developments led more and more Inuit to move to communities that had developed around trading posts, government administrative offices, radar sites, and mission churches. The Inuit could find construction jobs and other temporary work in these communities. But there was not enough work for all the Inuit. As a result, many of them began to receive housing and other assistance from the Canadian government.

In Greenland, many Inuit began fishing commercially during the early 1900's. This development resulted from a change in climate that warmed Greenland's coastal waters. The warm water drove the seals north and attracted cod, salmon, and other fish from the south.

Greenland was a colony of Denmark from 1380 until 1953, when it became a Danish province. At that time, the Inuit became Danish citizens. During the early 1900's and mid-1900's, the Danish government established programs to aid the Greenland Inuit. These programs provided improved education, housing, and health care. In addition, the Danish government helped train the Inuit for jobs in manufacturing, service industries, and other fields.

The Inuit today. The traditional way of life has ended for most Inuit. They live in wooden homes rather than in snowhouses, sod houses, or tents. They wear modern clothing instead of animal skin garments. Most Inuit speak English, Russian, or Danish in addition to their native language. The kayak and umiak have given way to the motorboat, and the snowmobile has replaced the dog team. Christianity has taken the place of most traditional Inuit beliefs.

Today's Inuit must compete in the modern economic world instead of the world of nature. While some Inuit have adjusted to their new ways of life, many suffer from unemployment and other problems. In addition, industrial and nuclear pollution are poisoning their traditional homelands and food sources.

Altogether, more than 100,000 Inuit live in Russia, Alaska, Canada, and Greenland. The Inuit population almost doubled between 1950 and 1970, and it continues to grow rapidly. This growth has resulted chiefly from improved health care and better living conditions.

Russia. About 1 percent of all Inuit live on the northeastern tip of Siberia. They hunt walruses, whales, seals, and other animals and produce carvings and other handicrafts for sale. They receive education, housing, and other benefits from the government.

Alaska has about 34 percent of the world's Inuit. Some Alaskan Inuit live in towns and cities. But the majority live in small settlements and hunt and fish for most of their food. Some Inuit work in the petroleum or mining industries. However, there is little other industry, so most of the state's Inuit are either unemployed or can find only temporary jobs. They depend on the U.S. gov-

Wolfgang Kaehler

Frank Mayrs, Tony Stone Images

Inuit artists, such as the printmaker and the sculptor in soapstone, have found a growing demand for their work. Many Inuit artists belong to organizations called *cooperatives,* which collect the artwork of their members and sell it throughout the world.

ernment for housing and other assistance. The government has greatly expanded the educational programs for the Inuit, and more than half of the young people complete high school.

In 1971, the United States Congress passed a bill that gave $962\frac{1}{2}$ million and 44 million acres (18 million hectares) of Alaskan land to the state's native peoples. These peoples are the Inuit, the *Aleuts* (a people native to Alaska's Aleutian Islands), and American Indians. Congress passed the bill in response to long-standing land claims made by the Inuit and Indians.

Canada has about 29 percent of the world's Inuit. Most of them live in towns in housing provided by the government. They also receive financial aid, health care, and other help from the government. About half of all Canadian Inuit cannot find permanent employment. To combat this problem, the government has helped the Inuit establish commercial fishing and handicraft cooperatives. These organizations have been especially successful in selling soapstone sculpture and prints, which have become increasingly popular in Canada and the United States. Educational opportunities have increased greatly for the Canadian Inuit since the 1950's, but most Inuit students do not finish high school.

In 1993, Canada's government passed legislation to create a vast new territory that would have an Inuit majority. The territory, called Nunavut, came into being in 1999. It covers a large part of northern Canada. The government also gave Canada's Inuit title to much of Nunavut's land.

Greenland has about 36 percent of all Inuit. Almost all these people have mixed Inuit and European ancestry. But most experts classify them as Inuit. In 1979, Denmark granted Greenland *home rule* status. This allows Greenlanders to control the internal affairs of the province, including Inuit affairs.

Most Greenland Inuit work in towns, chiefly in the fishing industry. Only the Inuit in northern Greenland still live mainly by hunting seals and continue many of their traditional ways. Most Greenland Inuit do not complete high school. Greenland's government provides them with housing, health care, and other assistance.

James A. Tuck

Related articles in *World Book* include:

Alaska (Visitor's guide; picture)
Aleuts
Arctic
Caribou
Clothing (pictures)
Greenland
Igloo
Kayak
Northwest Territories
Nunavut
Races, Human (Climatic adaptations)
Seal
Sled dog
Tundra
Walrus
Whale (The future of whales)

Outline

I. The land of the Inuit
- A. Climate
- B. Plants and animals

II. Traditional way of life
- A. Group life
- B. Food
- C. Clothing
- D. Shelter
- E. Transportation
- F. Hunting and fishing
- G. Religion
- H. Recreation
- I. Arts and crafts
- J. Language

III. History
- A. Inuit origins
- B. The arrival of Europeans
- C. New ways of life
- D. The Inuit today

Questions

In what countries do the Inuit live today?
Who were the first Europeans to meet the Inuit?
What two types of boats did the Inuit use?

What traditional methods have the Inuit used to hunt seals?
Why did the Inuit prefer caribou skin as a material for clothes?
What special rules did the Inuit follow to please the spirits?
In what types of houses did the Inuit live?
Why has the Inuit population grown so rapidly since 1950?
What foods have been part of the traditional Inuit diet?
Why is Inuit country called the Land of the Midnight Sun?
Where did Inuit culture originate?

Additional resources

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Inuvik, *ih NOO vihk* (pop. 2,894), is an administrative and commercial center in the northwestern part of Canada's Northwest Territories. Its population is made up of Inuit (formerly called Eskimos), Dene Indians, and whites.

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Inuvik is an administrative and commercial center in the northwestern part of Canada's Northwest Territories. The community lies along the Mackenzie River.

Inuvik was built in the 1950's to replace Aklavik as a regional administrative center. Aklavik had poor ground conditions and was often affected by the spring floods of the Mackenzie River. For location of Inuvik, see Northwest Territories (map).

G. Peter Kershaw

Invasive species are animals, plants, and other living things that spread rapidly in new environments where there are few or no natural controls on their growth. People transport large numbers of species from one region to another. Only a small portion of these *introduced species* become invasive, but invasive pests can cause great environmental damage. They crowd out native species, putting them at risk of extinction. They also cause billions of dollars in damage each year to agriculture, fisheries, forestry, and public health.

How species become invasive. People have carried species from one environment to another for thousands of years. But increases in travel since 1800 have greatly expanded the number and variety of introduced species. Travelers and cargo on ships, airplanes, or other vessels carry some creatures accidentally. Others are imported deliberately. People may introduce animals and plants to combat native species they consider harmful to agriculture. They may transport species as farm animals or as ornamental plants. People may even dump species into new habitats simply to get rid of them.

Some invasive pests spread quickly after they arrive in new environments. The zebra mussel, a kind of shellfish, arrived in North America from Russia in the late 1980's, carried in ballast water in the deep holds of ships. It quickly spread out of control in North American lakes, threatening native aquatic life. Some living things become invasive only after another invasive species arrives. In Florida, landscapers have used introduced ornamental fig trees for over 100 years. Until the 1980's, the trees grew only in yards and parks because they could not reproduce without the wasps that pollinated them. But in the 1980's, some of these wasps invaded the region, and now fig species are spreading into natural areas.

How invasive species affect habitats. Invasive species can prey on native ones, compete with them for resources, or alter them through mating. Some pests may change an entire habitat and endanger a wide array of native life.

Endangering native species. Invasive animals can directly threaten native species by preying on them. The brown tree snake traveled to the island of Guam in ship and airplane cargo from other South Pacific Islands. Since arriving on Guam, brown tree snakes have eliminated many of the island's native forest birds.

Invasive species may also drive out native life by competing for food, light, and other natural resources. In the United Kingdom, competition between invasive North American gray squirrels and native red squirrels has caused the red squirrel population to decline. In warm North American waters, the South American water hyacinth has become so abundant that it keeps sunlight from reaching submerged native plants, threatening these plants' survival.

Invasive species can gradually change and even extinguish native species by mating with them. The rainbow trout, a popular food and sport fish from western North America, has been introduced to other areas to boost local fisheries and sport fishing industries. Some of these trout mate with native trout species, producing hybrids. In certain cases, the hybrids are replacing native trout.

Altering habitats. An invasive pest can alter an entire

habitat in ways that threaten many native species. In parts of Florida, Australian paperbark trees with highly flammable leaves and twigs have increased the number and intensity of forest fires. This environmental change has driven out native plants not adapted to frequent or intense fires. The loss of native vegetation has, in turn, harmed native animals that relied on the old plants for food and shelter.

In the Mediterranean region, a variety of *Caulerpa* seaweed from Australia has become a major pest. In 1984, an aquarium in Monaco accidentally released it into the Mediterranean Sea. Since then, the seaweed has grown out of control on seabed habitats throughout the Mediterranean region. Overabundance of *Caulerpa* has led to the decline of fish and other sea animals in those areas.

Invasive pests can also damage habitats by spreading disease. For example, the Asian fungus that causes *chestnut blight* disease was introduced to North America in the late 1800's. Chestnut blight not only killed most North American chestnut trees, but it also affected moths, birds, and mammals that relied on these trees.

Managing invasive species. The most effective way to manage invasive species is to keep them out. Many nations restrict the importation of species that might become damaging or of products that can carry them—such as untreated wooden packing material.

To combat invasive species after they arrive, people can use one or more of four basic approaches. They are *mechanical control, chemical control, biological control,* and *ecosystem management.*

Mechanical control methods include trapping animals and uprooting plants. Such methods often prove quite effective. People in the United Kingdom completely eliminated the nutria, an invasive South American rodent, through trapping. But mechanical control usually involves intensive human labor. The United States has combated the Asian long-horned beetle, a pest imported from China, by cutting down and burning hundreds of beetle-infested trees.

Chemical control. People employ chemical pesticides to manage many introduced species. Pesticides have helped control such pests as the *Anopheles* mosquito, which spreads the disease malaria. But chemicals can prove expensive, particularly if used over large areas. Moreover, many pesticides become ineffective if species develop resistance to them.

Biological control involves introducing a natural enemy of an introduced pest to reduce the pest's numbers. In Africa, for example, the South American cassava mealybug once devastated cassava plant crops. This problem was controlled by an imported South American wasp that preyed on the mealybug.

Biological control agents can also cause harmful side effects. Pacific islanders introduced the North American rosy wolf snail to many islands to control the previously introduced giant African snail. The rosy wolf snails not only failed to control the African snails but also attacked native snails, eventually driving some of them to extinction. The Russian wheat aphid, a native of southeastern Europe and southwestern Asia, reached the United States in 1986. It quickly spread through western North America and nearly eliminated wheat and barley crops in certain areas. To combat the aphid, farmers distributed the Eurasian sevenspotted lady beetle. But this beetle competed fiercely with native ladybugs for natural resources, threatening native populations.

Ecosystem management. Management of an entire *ecosystem*—that is, all living and nonliving things in a particular place—is the newest method of controlling invaders. For instance, many North American farmers and ranchers prevent livestock from overgrazing on native grasses. This policy helps keep an invasive plant called the Eurasian musk thistle from becoming a damaging weed. If native grasses remain plentiful, they can successfully compete with the thistle and keep its numbers low.

Daniel Simberloff

Related articles in *World Book* include:

Conservation
(Biodiversity conservation)
Goby
Gypsy moth
Ice plant
Kudzu
Ruffe
Spurge
Water hyacinth
Zebra mussel

© John Pontier, Earth Scenes

Water hyacinth may look attractive, but this South American plant has become a harmful invasive species in North America. Mats of water hyacinth, such as this in Guatemala, cover large areas of rivers and lakes. They prevent sunlight from reaching submerged native plants, threatening the plants' survival.

WORLD BOOK photo by Steven Spicer

A kitchen appliance

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A classroom computer

T. Tracy, FPG

A laboratory robot

Inventions enable us to lead easier, more enjoyable lives. Some inventions provide labor-saving assistance in the home. Others aid students in school or help workers perform various tasks.

Invention

Invention is the creation of a new device, process, or product. Our inventions have given us control over our environment and enabled us to live better, easier, and happier lives. If we could not invent, we would be at the mercy of the climate and the land. Inventions have enabled people to survive the hazards of the environment and develop a civilized society.

Down through history, inventions have changed the way people live. Little by little, they have helped determine where people live and the kind of work they do. Inventions have also influenced what people eat and wear and how they play and relax. Many thousands of years ago, people lived by hunting animals and gathering wild plants. To find food, most people had to move from place to place. About 9000 B.C., people began to grow their own food and raise livestock. The invention of agricultural methods meant that people no longer had to wander about in search of food but could settle in farm villages. Then came the Industrial Revolution in the 1700's, with such inventions as spinning and weaving machines and the steam engine. These inventions produced another great change in the way people lived, as people flocked to the cities to work in factories.

An invention differs from a discovery, but they are closely related. A discovery occurs when something that exists in nature is observed or recognized for the first time. An invention is the creation of something that never existed before. For example, people discovered fire. But they invented the match to start a fire.

Terry S. Reynolds, the contributor of this article, is Professor of History at Michigan Technological University.

Invention is also related to *innovation*. Innovation is a change made in an established way of doing something. An innovation can make an invention more accessible to people, thereby increasing the use of the invention.

Henry Ford, who founded the Ford Motor Company, was an outstanding innovator. Ford did not invent the automobile, but he brought several innovations to the manufacture of automobiles. These innovations included an assembly line method of production, and having the company make, rather than buy, automobile parts. Ford's innovations enabled the company to slash the price of its automobiles, putting the prices within reach of the average family.

Although most inventions have benefited people, some inventions, such as weapons of war, have been harmful. Certain other inventions have been both beneficial and harmful. The automobile, for example, has given us a fast, convenient means of transportation. However, it has also contributed greatly to air pollution.

Air pollution is only one of the many problems that people face today. Large numbers of cities are overcrowded. More than half the world's people do not have enough to eat. Heart disease and other illnesses kill countless millions every year. Invention is one of the ways people try to solve these and other problems.

Why people invent

People invent for several reasons. Many people hope to make money from their inventions. Others invent to satisfy their curiosity or an urge to create. However, the greatest spur to invention has been to satisfy the needs of certain groups of people. These needs can be divided into three categories: (1) economic needs, (2) military needs, and (3) social needs. An invention must satisfy some need in one of these categories, or people will ignore it. A large number of inventions have never come

into use because they failed to fill a need.

Economic needs have led to most inventions. These inventions include not only the thousands of devices and machines used in agriculture, business, and industry, but also many kinds of processes and products.

An economically successful invention may create an economic need for additional inventions. An example is the flood of inventions that revolutionized the British textile industry during the 1700's.

In 1733, John Kay, an English inventor, devised a weaving machine called the *fly shuttle*. The fly shuttle enabled weavers to produce cloth much faster than spinners could supply them with thread. The textile industry either had to find many more spinners or speed up the spinning process.

During the 1760's and 1770's, three English inventors—James Hargreaves, Sir Richard Arkwright, and Samuel Crompton—produced a series of inventions that enabled workers to spin thread much faster. Suddenly, the textile industry had much more thread available than weavers and weaving machines to make cloth. Then, during the mid-1780's, Edmund Cartwright, another English inventor, invented a power loom. This loom wove cloth so quickly that weavers could keep up with the large amounts of thread spun on spinning machines.

The new spinning and weaving machines enabled textile manufacturers to produce great quantities of cotton cloth at lower costs. As a result, manufacturers could sell the cloth at reduced prices, thereby creating a large new market for it. The demand for raw cotton thus increased, and so a new problem arose. Raw cotton contains seeds that must be removed before the cotton can be used on spinning machines. Workers removed the seeds by hand, a slow process that could not keep pace with the demand for cotton. In 1793, the American inventor Eli Whitney built his cotton gin. This machine could remove the cotton seeds as fast as 50 people working by hand. It enabled cotton growers to meet the demands of the spinning and weaving machines.

Military needs. War and the threat of war have often stimulated invention. A nation at war encourages its inventors, engineers, and scientists to create new weapons that will be more destructive than those of the enemy. But war has also led to many inventions that have had valuable peacetime uses.

World War II (1939-1945) stimulated more research and invention than any other war. The war produced the most destructive single weapon ever used in warfare—the atomic bomb. Yet many inventions that came out of the war have benefited people enormously. Nuclear energy, first used in the atomic bomb, now provides power for homes and industry. The war also stimulated the development of radar, an invention that plays an important part today in aviation and in weather forecasting.

Social needs have brought about thousands of inventions and discoveries. Many of these inventions and discoveries have eased threats to health and have prolonged life. Others have made life easier and more comfortable.

Many inventions have helped people in the battle against disease. Some have enabled doctors to diagnose diseases. Others have helped make possible the discovery of new drugs and techniques to treat illnesses. Scientists could never have made significant advances in the fight against infectious diseases without the compound microscope. Zacharias Janssen, a Dutch optician, invented the compound microscope about 1590. In 1853, Charles Pravaz, a French physician, invented the hypodermic syringe, which enables doctors to easily administer drugs under the skin. In the mid-1900's, Jonas E. Salk and Albert B. Sabin, two American doctors, developed vaccines that help prevent poliomyelitis.

Inventions that make our lives easier and more comfortable include the many appliances and products in our homes. The vacuum cleaner, patented by several inventors around 1900, is one of the large number of devices that reduce housework. Canned foods and commercially frozen foods help make the planning and preparation of meals easier. Clarence Birdseye, an American inventor, developed the quick-freezing process of preserving food in the 1920's.

How people invent

People have produced millions of useful inventions, from the simplest prehistoric devices to the most complicated modern machines. Inventions generally develop from what can be called the *inventive process*. In this process, an inventor first recognizes a need for an invention. The inventor then combines knowledge and skills with proper materials to create a useful invention.

From the beginning of civilization (about 3500 B.C.) until the 1900's, most inventions were produced by individual inventors who worked alone and relied largely on their own knowledge and skills. Today, the individual inventor has largely been replaced by groups of scientists and technicians working together in government, industrial, and university research laboratories. By pooling their abilities, specialists greatly increase the chances of creating useful inventions.

The inventive process. According to an old saying, "Necessity is the mother of invention." But it takes more than necessity for an invention to be created. For example, the need for fast communications over great distances existed long before the invention of the radio, telegraph, and telephone. We still do not have a cure for the common cold or for many other illnesses. An inventor thus cannot create an invention simply by recognizing that some people have a need for it. The successful inventor must also possess three important factors: (1) the knowledge, (2) the technical capacity, and (3) the creative insight to produce the invention.

Knowledge. To create an invention, the inventor must have some practical understanding of how it will work. One of the earliest and most important inventions was the bow and arrow. The prehistoric person who invented the bow and arrow had to know that a tree branch could bend to serve as a bow. The person also had to understand that an arrow could be shot by pulling back a string attached to both ends of the branch, then releasing the string.

Technical capacity refers to the materials, parts, and tools that an inventor must have to create an invention. Throughout history, inventors have had ideas for inventions but lacked the technical capacity to produce them.

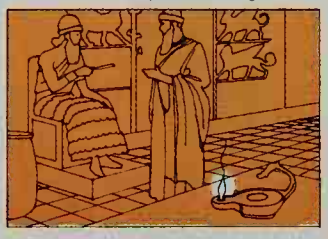
Inventions that give people light

Human inventiveness can be shown by the devices that have been developed to produce artificial light. For thousands of years, people relied on the oil lamp and the candle. During the 1800's, gas lamps and kerosene lamps provided artificial light. Today, industrial countries depend almost entirely on incandescent, neon, and fluorescent lights. Rows of powerful runway lights, *bottom right,* enable a plane to land safely at night.

WORLD BOOK illustrations by David Cunningham

Artstreet

Oil lamp



Bronze candlestick (1200's) by unknown artist; courtesy *Friends* magazine

Candle

Bettmann Archive

Gas lamp

Arizona Photographic Associates

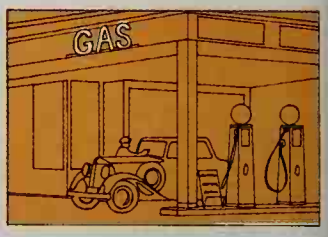
Kerosene lamp

Historical Pictures Service

Incandescent light

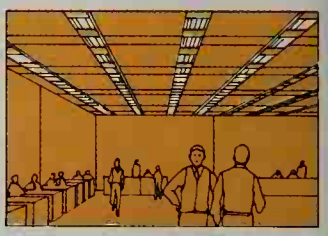
Ken Firestone

Neon light



WORLD BOOK photo

Fluorescent light



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Artificial lights illuminating an airport runway

For example, many inventors wanted to build a flying machine long before the 1900's. But one of the essential parts they needed—an engine powerful enough to make their machine fly, yet small enough to be practical—did not exist. Such an engine—the gasoline engine—was not developed until the late 1800's. The development of this engine helped make it possible for two American inventors, Orville and Wilbur Wright, to build the first successful airplane in 1903.

Creative insight is an inventor's ability to arrive at the key idea that blends his or her knowledge and technical capacity into an invention. In most cases, an inventor comes up with this key idea after a long period of trial and error. Occasionally, an inventor forms an important idea as a result of an accident.

Trial and error is not simply a hit-or-miss procedure. The inventor must first carefully define the problem. The inventor must then patiently experiment with different designs or materials until one that solves the problem is found. For example, Orville and Wilbur Wright knew they needed specially shaped wings that would help lift an airplane off the ground and keep it in the air. The brothers tried many shapes before finding one that provided sufficient lifting power.

After years of unsuccessful experiments, an inventor may accidentally stumble onto the key idea that leads to his or her invention. The American inventor Charles Goodyear tried for five years to find a way to make rubber a useful product. He wanted rubber that would not melt in the heat or become brittle and stiff in the cold. Goodyear applied various treatments to *gum elastic,* as he called rubber, but none worked.

One winter night in 1839, Goodyear was at home talking with his brother. In his hand, Goodyear held a piece of rubber on which he had sprinkled sulfur. He accidentally dropped the rubber onto a red-hot stove. To his surprise, instead of melting, the rubber flattened out into a small disk. After he lifted the rubber from the stove, he found it was still flexible and strong. Goodyear hung the disk on his doorpost overnight in the winter cold. The next morning, the disk still had its rubberlike qualities. Goodyear had accidentally invented *vulcanization*—the process of heating rubber treated with sulfur to give the rubber elasticity, hardness, and strength.

In nearly all cases of accidental inventions, the inventors were highly trained specialists. They had worked on the invention a long time and were alert to its problems. Goodyear had the intelligence and experience to recognize that an accident had provided him with the key idea that solved his problem.

Research laboratories. No individual inventor could possibly possess all the scientific and technical knowledge that a research laboratory team has. The availability of so much knowledge greatly increases each team member's capacity to invent. Also, research laboratories provide complex equipment that few people could afford as individuals.

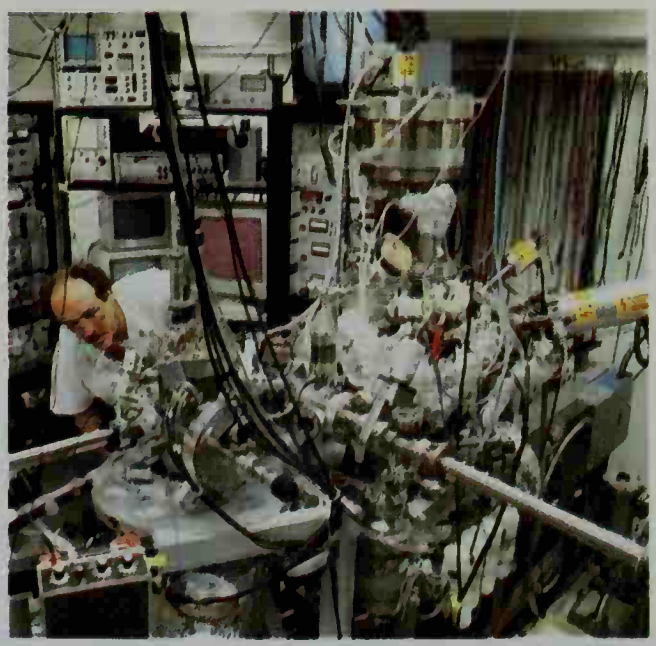
The invention of the transistor—one of the most important electronic devices ever developed—is an example of how research laboratories work. In the late 1930's, the Bell System, which then operated most of the telephones in the United States, expected an increase in telephone use. The system asked its associated research organization, the Bell Telephone Laboratories (now part of Lucent Technologies, Inc.), to find a way to handle the increase. Scientists and engineers at the Bell laboratory in Murray Hill, New Jersey, were assigned the problem. They decided that the solution lay in creating a device that would improve the operation of telephone switching equipment. This equipment controls the number of calls that can be placed at one time.

A crucial part of the switching equipment was the vacuum tube. Personnel at the Bell laboratory decided to try to create a device more efficient than this tube. The Bell scientists knew the mathematical equations and the principles of physics that related to the problem. The company's engineers understood the materials and processes that could be used to make the device. Combining their knowledge, these specialists invented the transistor in 1947. The transistor is lighter, smaller, and more durable than the vacuum tube. It also starts to work the instant it is turned on and operates on much less power than the vacuum tube does.

The history of inventions

Prehistoric times. The first inventions appeared in the Paleolithic Period, or Old Stone Age, which lasted from about 2 $\frac{1}{2}$ million years ago to about 8000 B.C. Paleolithic people discovered they could make axes, chisels, and other tools by chipping bone, flint, horn, ivory, and stones into the desired shapes. They also invented the bow and arrow and the spear. These weapons helped early people hunt wild animals more efficiently for food. Paleolithic people also discovered that by striking flint against metal ore, they could make fire.

People learned how to grow crops near the end of the Paleolithic Period. They invented the hoe, sickle, and other tools to grow better crops and to help in harvest-



IBM Research Laboratory, Zurich, Switzerland

Research laboratories, such as the one shown here, bring together the complicated equipment and scientific knowledge needed to make and develop highly technical inventions.

ing them. The development of agriculture meant that people no longer had to move from place to place in search of food. The early farmers began to settle in villages, which became the ancestors of the first cities.

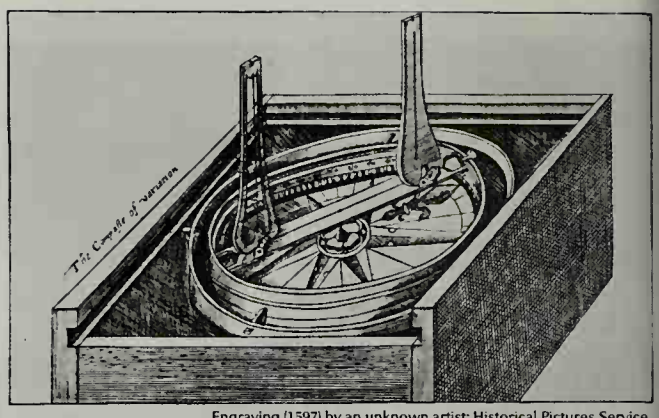
When prehistoric people hunted animals, they used animal skins for clothing. But early farmers needed a new source of clothing because they killed few animals for food. They thus invented textiles. To make textiles, people invented spinning devices to produce thread from animal and plant fibers and a loom to weave the thread into cloth.

No one knows when people first made metal objects. Scholars believe Neolithic people beat and hammered such metals as copper, gold, and silver into ornaments, tools, and weapons. As early as 3500 B.C., people had also learned that two elements—at first copper and arsenic, later copper and tin—could be melted and mixed to produce bronze, a stronger, more durable metal.

One of the most important inventions in history—the wheel—appeared about 3500 B.C. Before the invention of the wheel, people carried their burdens on their backs or dragged them on heavy sleds called *sledges*. They also used animals to carry loads. The invention of the wheel led to the development of wagons, which enabled people to move goods more easily and to transport larger loads than ever before.

The first civilizations developed between about 3500 and 3100 B.C. in river valleys—between the Tigris and Euphrates rivers of Mesopotamia and in the Nile Valley of Egypt. These civilizations were based on agriculture. They originated in river valleys because of the fertility of the land. The rivers flooded each year, depositing large amounts of rich soil in the valleys. The peoples of these valleys invented systems of canals, dikes, and ditches to extend the area of land they could farm by irrigation. These systems also controlled the drainage of the floodwaters back into the rivers.

Perhaps the most important invention of the early civilizations was writing. The Sumerians, who lived in southern Mesopotamia, developed the first system of writing. Historians believe the Sumerians invented the system about 3500 B.C. The invention of writing meant that people no longer had to remember all knowledge. They could write down ideas and information for later use.



Engraving (1597) by an unknown artist; Historical Pictures Service

The magnetic compass was invented in ancient China. Using compasses like the one pictured here, explorers of the 1500's plotted their courses to distant lands.

Also, for the first time, they could communicate over long distances by having their writing carried from one place to another. Writing also preserved ideas and knowledge for future generations.

Ancient Greece. A great civilization developed in Greece by about the 500's B.C. The ancient Greeks are best known for their achievements in the arts, philosophy, and science. But they also produced many inventions. The most important Greek inventors included Ctesibius, Archimedes, and Hero.

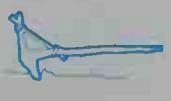
Ctesibius (pronounced *tee SIHB ee uhs*) lived during the 200's B.C. in Alexandria, Egypt, then a great center of Greek learning and culture. He built the first piston pump. It consisted of a cylinder with a plunger inside. As the plunger was moved up and down, it created pressure that could be used to pump water.

Archimedes lived during the 200's B.C. in Syracuse, a Greek city in Sicily. He is most famous for his great mathematical discoveries, but he also produced many inventions. The best-known invention attributed to him was the *Archimedean screw,* which was designed to raise water from a lower level to a higher one. It was used in ancient Egypt to drain and irrigate land in the Nile Valley. The device consisted of a screw tightly fitted inside a cylinder that had two open ends. The lower end of the device was placed in the water. Attached to the

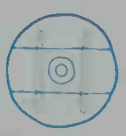
Important inventions in history

People have invented since earliest times. But many of the most important inventions have been developed in the last 600 years. These inventions have revolutionized every element of civilization, including agriculture, communications, industry, science, transportation, and war. The drawings on this and the following pages illustrate some major inventions.

Flint tools
About 1,750,000 B.C.

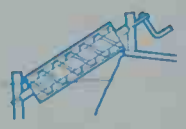


Plow
5000-3000 B.C.



Wheel
About 3500 B.C.

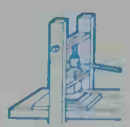
Magnetic compass
As early as 300's B.C.



Archimedean screw
200's B.C.

Paper
By A.D. 1

Cannon
About 1350

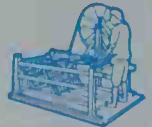


Printing from movable type
About 1440

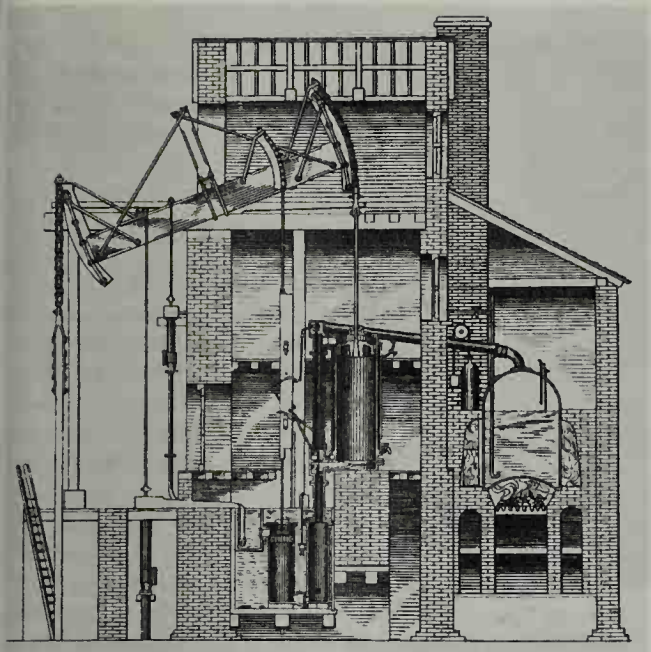
Compound microscope
About 1590

Telescope
1608

Steam engine
1690-1769



Spinning jenny
About 1764



Brown Brothers

James Watt's steam engine played a vital role in the development of the Industrial Revolution in the 1700's. The engine provided a cheap, efficient source of power to operate machinery.

screw at its upper end was either a handle or a device that turned the screw when people walked on it. The turning action lifted the water up along the threads of the screw and out the upper end.

Hero lived during the first century A.D. in Alexandria. His most important invention was the *screw press,* a device for squeezing the juice from grapes to make wine and from olives to make olive oil. Earlier presses provided only limited pressure, and so they left much of the juice in the fruits. The screw press had a threaded shaft attached to the wood block that squeezed the fruits. By turning the shaft, greater pressure could be applied to the grapes and olives. As a result, Hero's screw press squeezed much more liquid from the fruits than earlier presses did.

China produced many of the most important inventions. In time, many of them were carried to Europe, where they helped shape Western history. More than 2,000 years ago, the Chinese invented the magnetic compass and paper. The Chinese also invented porcelain. The earliest surviving examples of Chinese porcelain date from A.D. 618 to 907, when the Tang dynasty ruled China. But the Chinese may have begun to make porcelain before the birth of Christ.

About A.D. 1045, Bi Sheng (Pi Sheng), a Chinese printer, invented movable type. He made separate pieces of clay type for each character in the Chinese language. But Bi Sheng's invention was not carried to the West. Movable type was invented separately in Europe about 400 years later.

The Middle Ages, which lasted from the A.D. 400's to the 1500's, produced great changes in the way of life in Europe. Many of these changes resulted from inventions in agriculture, transportation, and warfare.

The invention of the rigid horse collar about 800 helped advance both farming and land transportation. Before this invention, horses wore a harness that fit across the throat. When a horse pulled too hard, the harness cut off its breathing. The rigid collar, however, shifted the pressure of the load to the horse's shoulders. Using the collar, a horse could pull a much heavier load.

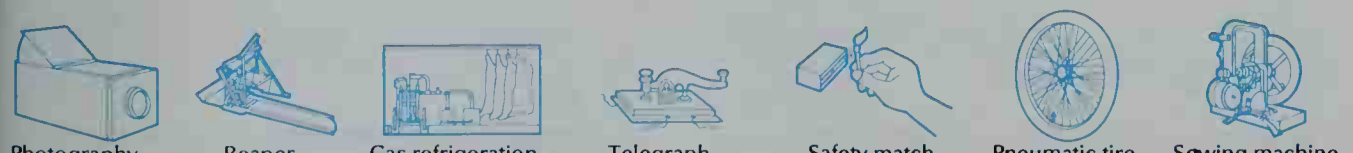
Water transportation benefited from several medieval inventions. One was the triangular *lateen sail,* which had appeared around 200 and gradually spread during the Middle Ages. Square sails had been widely used for several thousand years, but they worked well only when the wind blew from behind a ship. But lateen sails worked well when a ship sailed into the wind. When the two types of sails were mounted on the same ship, that ship could then work well in both conditions.

The magnetic compass had reached Europe from China by 1200. This compass enabled sailors to navigate accurately when they could not see land and when they could not use the stars or sun as guides.

The *sternpost rudder* appeared about 1300. Before this invention, ships were steered by large oars near the stern. These steering oars were awkward and often broke during storms. The use of steering oars also limited the size of many ships and how far they could sail from land. The rudder could be used to steer larger ships. It also enabled the ships to sail safely in rough

WORLD BOOK illustrations by Mas Nakagawa and by Graham Studios

Balloon 1783 · Steamboat 1787-1807 · Cotton gin 1793 · Food canning 1795-1809 · Steam locomotive 1804 · Stethoscope 1816 · Portland cement 1824



Photography 1826 · Reaper 1831 · Gas refrigeration 1834 · Telegraph 1837 · Safety match 1844 · Pneumatic tire 1845 · Sewing machine 1846

Bettmann Archive

Thomas Edison was one of the greatest inventors in history. This picture shows Edison listening to an early version of the phonograph. Edison invented the phonograph in 1877.

seas and, combined with other inventions in shipbuilding and navigation, helped make possible the great voyages that led to the exploration of the New World.

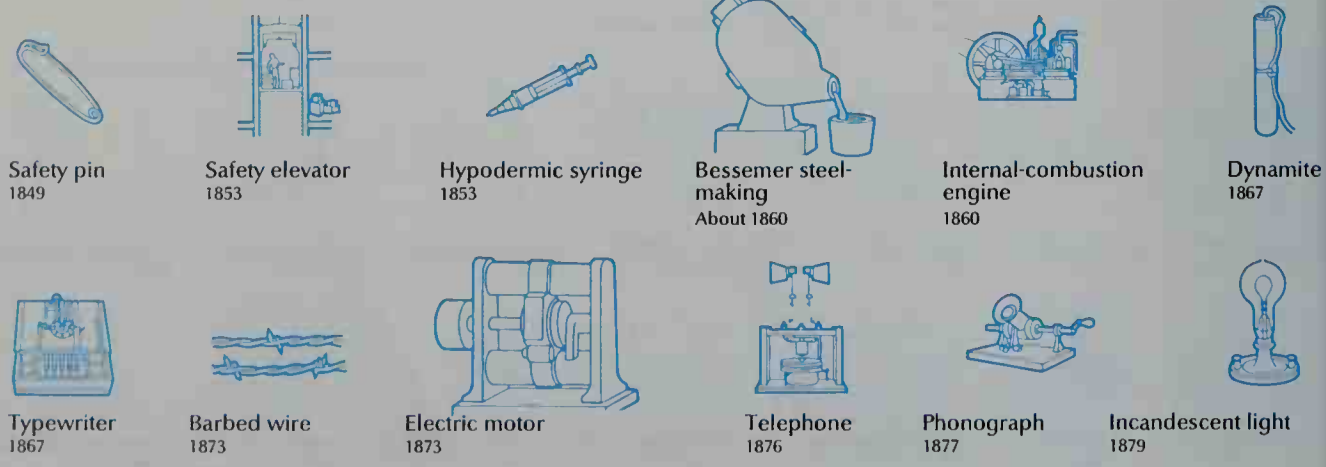
One of the most important inventions of the Middle Ages was the stirrup, which came to Europe from India by way of China. The stirrup, when added to a saddle, enabled soldiers to fight better on horseback. Before the stirrup, foot soldiers did most of the fighting. With the development of the stirrup, mounted warriors called knights became more important.

The Renaissance began about 1300 and lasted until the 1600's. During this period of cultural awakening in Europe, fewer inventions appeared than during the Middle Ages. But the Renaissance did introduce to the Western world two of the most important inventions in history—gunpowder and printing.

Gunpowder was invented in Asia before A.D. 900. It was brought to Europe about 1250 by travelers who saw it being used in the East. Gunpowder changed the nature of warfare in Europe. Medieval knights could not defend themselves against firearms and cannons, which replaced such weapons as the crossbow and the spear. Knights were replaced in battle by artillery and foot soldiers armed with firearms.

In the mid-1400's, Johannes Gutenberg of Germany invented printing as we know it today. Printing is an example of how one invention can be created from several other inventions. Ink, movable type, paper, and the press had been invented long before Gutenberg's time. But Gutenberg creatively combined these inventions to produce printing. Printing quickly became the first means of mass communication. It put more knowledge in the hands of more people faster and at less cost than ever before. Printing thus helped make possible the development of modern democracies, which rely on well-informed citizens to participate in government.

The Age of Reason, a period of great intellectual activity, began in the 1600's and lasted until the late 1700's. During this period, many important inventions appeared and, for the first time, science began to contribute to invention. Some scientists produced inventions themselves. For example, the Italian scientist Galileo invented an improved sector, an instrument used to draw and measure angles. Other scientists, such as Sir Isaac New-



ton of England, provided the scientific knowledge that led to later inventions or to refinements in existing inventions. Newton's laws of motion, published in *Principia* (1687), played a vital role in the improvement of jet propulsion engines and rocket engines in the 1900's.

Galileo's sector was only one of several important scientific instruments invented during the Age of Reason. The telescope was probably invented by Hans Lippershey, a Dutch optician, in 1608. In 1644, Evangelista Torricelli, an Italian physicist, wrote a description of his new invention, the barometer.

Many inventions that appeared during the Age of Reason were new machines and new methods for planting and harvesting crops. These inventions contributed to a great change in farming called the Agricultural Revolution. One important invention was the seed drill, invented about 1700 by Jethro Tull, an English gentleman farmer. Before Tull's invention, farmers sowed seeds by throwing them on the ground. This was a wasteful method of sowing seeds. The seed drill bored straight rows of holes in the ground, and farmers dropped the seeds into the holes.

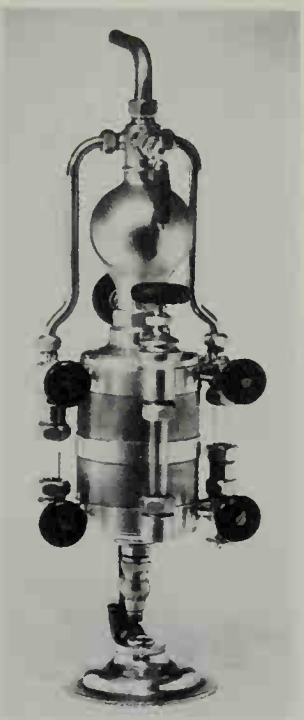
The Industrial Revolution began in the United Kingdom during the 1700's. By the mid-1800's, the Revolution had spread throughout western Europe and to the United States. It not only revolutionized industry, but it also greatly changed cultural, political, and social life.

Many important inventions contributed to the growth of the Industrial Revolution. The *Economic needs* section of this article describes some inventions that revolutionized the textile industry. But the most important machine produced during the Industrial Revolution was the steam engine developed by the Scottish inventor James Watt. Watt did not invent the first steam engine. Crude engines came into use before his time, but they were inefficient and costly to operate. In the 1760's, Watt invented an improved engine. Other inventors found new uses for the Watt engine, and it quickly became the chief source of power for transportation and industry.

In 1787, John Fitch demonstrated the first workable steamboat in the United States. Richard Trevithick, an English engineer, invented the steam locomotive in 1804. In 1839, James Nasmyth, a Scottish engineer, invented the steam hammer for shaping metal. In 1884, Charles A. Parsons, an English engineer, designed the first successful *steam turbine.* In 1897, he showed that this new type of engine could propel ships more powerfully and efficiently than previous steam engines.

Moorland-Spingarn Research Center, Harvard University

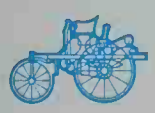
Elijah McCoy was an American engineer and inventor who developed the automatic lubricator in the early 1870's. Before he invented this device, machines had to be shut down for lubrication. McCoy designed a variety of automatic lubricating equipment, including a device for locomotives, *shown here.*



Henry Ford Museum & Greenfield Village

In the early 1830's, two physicists—Michael Faraday of England and Joseph Henry of the United States—independently made a discovery that led to the development of electricity as an important source of energy. Faraday and Henry found that as they moved a coil of copper wire near a magnet—or a magnet near a coil of copper wire—they created an electric current in the wire. The two men thus discovered the principle of *electromagnetic induction.* Inventors quickly realized that electricity could be used in many ways. In 1832, Hippolyte Pixii, a French instrument maker, invented the first direct-

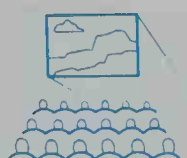
Skyscraper
1885



Gasoline automobile
1885

Diesel engine
1892

Zipper
1893

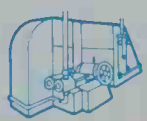


Motion picture
Mid-1890's

Radio
1895

X-ray machine
1895

Safety razor
1901

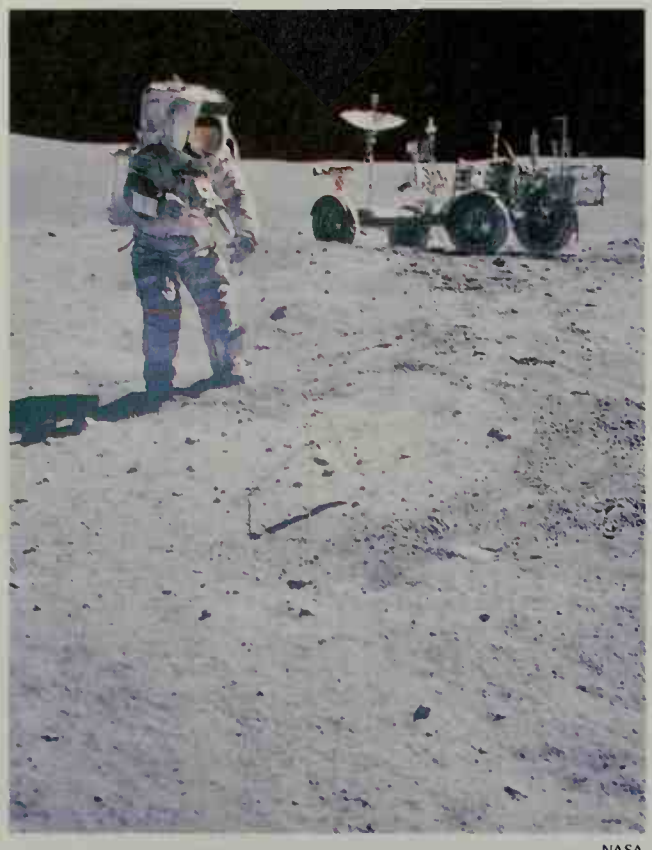


Air conditioning
1902

Airplane
1903

Helicopter
1907

Battle tank
1916



NASA

Space age inventions have made exploration of the moon possible. Astronaut James B. Irwin rode on the moon's surface in 1971 in a specially developed *lunar roving vehicle.*

current generator using the induction principle. The British inventors William F. Cooke and Charles Wheatstone patented an electric telegraph in 1837, and American inventor Samuel F. B. Morse patented one in 1840.

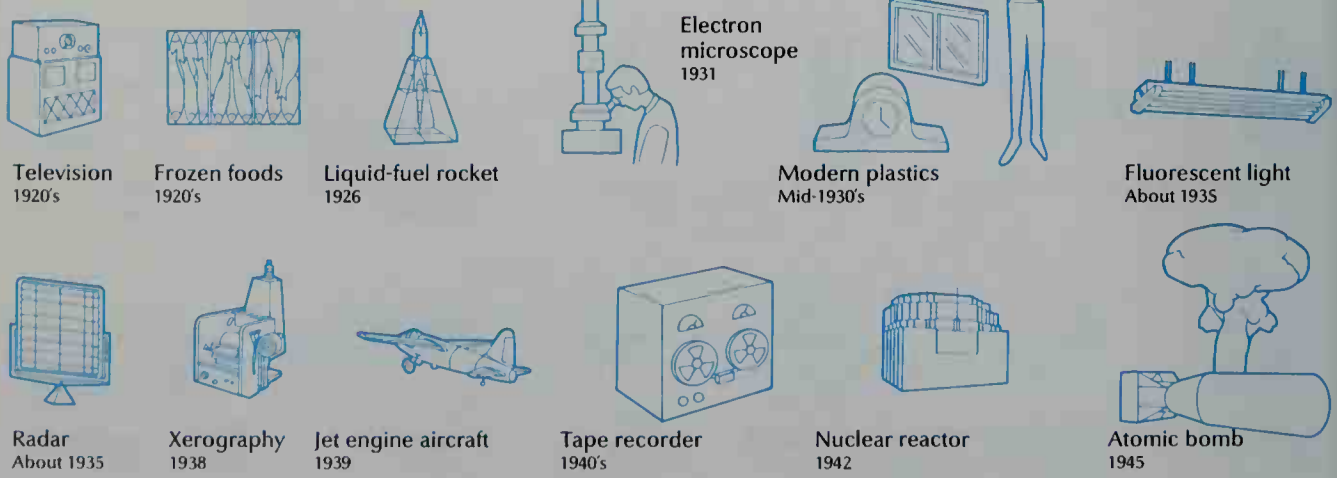
The Agricultural Revolution continued into the Industrial Revolution. In the early 1700's, an English nobleman named Charles Townshend invented a new method of crop rotation on his farm in the county of Norfolk. The method later became known as the *Norfolk system.*

Since the Middle Ages, farmers had allowed a third of their fields to lie *fallow* (unplanted) each year. This gave the fallow soil time to regain minerals absorbed by the crops. Townshend discovered that certain crops, such as alfalfa and clover, could restore minerals to the soil. In addition, the crops could be harvested and used for animal *fodder* (food). By rotating fodder crops with regular grain crops, farmers could keep all their land in production each year and still maintain the mineral content of the soil. Fodder crops also led to better-fed livestock, which meant more and higher-quality bacon, beef, mutton, pork, milk, and wool. The healthier animals provided still another advantage because they supplied more and better manure for fertilizing the farmland.

The late 1800's. During the 1800's, several inventors tried to develop an engine that was more efficient than the steam engine. In 1860, Jean Joseph Étienne Lenoir of France built one of the first practical internal-combustion engines. It produced power by burning fuel inside a closed cylinder. The internal-combustion engine was simpler, smaller, and more efficient than the steam engine, which burned fuel outside the cylinder. In 1885, Karl Benz and Gottlieb Daimler, two German inventors working independently, built internal-combustion engines that were basically the same as the gasoline engines used in automobiles today. Although cars running on internal-combustion engines at first competed with vehicles powered by steam engines and electric batteries, they gradually replaced them.

Several inventions revolutionized communication during the late 1800's. In 1867, American inventor Christopher Latham Sholes, with the help of Carlos Glidden and Samuel W. Soulé, invented the first practical typewriter. In 1876, the Scottish-born inventor Alexander Graham Bell patented the telephone. Ottmar Mergenthaler, a German living in the United States, patented the Linotype machine in 1884. This invention eliminated the need to set type by hand and thus speeded up the printing of books, magazines, and newspapers. In 1895, Guglielmo Marconi of Italy invented the wireless telegraph, or radio.

In 1895, German physicist Wilhelm C. Roentgen discovered X rays. This discovery led to the invention of the X-ray machine. The use of X rays revolutionized medical



and surgical techniques. X rays are also widely used in industry and scientific research.

Thomas A. Edison, one of the greatest inventors in history, patented his first invention, a vote recorder, in 1869. By the time he died in 1931, Edison had received 1,093 patents. He produced many of his most important inventions during the late 1800's. They included the incandescent light, a mimeograph machine, a motion-picture camera and projector, and the phonograph.

Industrial research laboratories began in the German chemical industry during the late 1800's. In 1876, Edison set up the first U.S. research lab, in Menlo Park, New Jersey. His laboratory was not affiliated with a particular industry, as other labs were. Edison hired scientists and technicians primarily to assist him in putting his own ideas into practice.

The early and middle 1900's. The automobile became a major means of transportation in the early 1900's, partly because of new inventions that made cars easier and safer to operate. In 1911, Charles F. Kettering, an American inventor, developed the electric self-starter. Before the self-starter, auto engines had to be cranked by hand to be started. Kettering's invention enabled a person to start an engine by simply pushing a button. In 1918, Malcolm Loughead of the United States invented a hydraulic four-wheel brake system. This system enabled drivers to stop their automobiles more safely than earlier brake systems did.

Orville and Wilbur Wright made the first successful airplane flights in 1903. Their plane used an internal-combustion engine. Jet engines were first used in warplanes during World War II (1939-1945). The chief inventors of the jet engine were Sir Frank Whittle of the United Kingdom and Willy Messerschmitt and Hans von Ohain of Germany.

The development of the vacuum tube in the early 1900's led to the founding of the electronics industry. In 1904, Sir John A. Fleming, a British electrical engineer, invented the diode, a vacuum tube that could detect radio signals. In 1907, Lee De Forest, an American inventor, patented the triode, an improved vacuum tube. About 1910, Edwin Howard Armstrong, an American engineer, showed how the triode could be used to strengthen radio signals. Engineers continued to improve the vacuum tube. The device played a vital part not only in the growth of radio, but also in the development of radar, the telephone, television, and other electronic equipment.

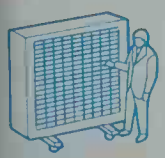
In 1947, scientists and engineers of the Bell Telephone Laboratories invented the transistor. This device has many advantages over the vacuum tube and largely replaced it in electronic equipment.

The early and middle 1900's produced many new materials. In 1909, Leo H. Baekeland, an American chemist, patented the first completely synthetic resin, Bakelite. Bakelite was one of the first plastics. In the mid-1900's, scientists working in research laboratories created synthetic fibers from such materials as acrylic, nylon, and polyester.

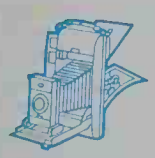
Many inventions of the early and middle 1900's took place in agriculture. Scientists developed new breeding techniques to improve animals and plants. New machines were invented to plant, cultivate, and harvest various crops. The chemical industry developed synthetic chemical fertilizers to enrich the soil, as well as other chemicals to help control harmful insects and animal and plant diseases. George Washington Carver of the United States was one of the leading agricultural scientists of the early 1900's. Carver won international fame for his agricultural research, through which he developed hundreds of useful products from peanuts.

By the mid-1900's, several inventors had combined many ideas and devices to produce the electronic computer—one of the most far-reaching inventions in history. Computers can handle information with incredible speed, solve lengthy mathematical problems in a fraction of a second, and do an enormous variety of other jobs. They are used in business, education, government, industry, science, and the home. Astronauts use computers to keep their spacecraft on course. Businesses use computers to keep accounts, figure out payrolls, print paychecks, and do many other tasks. Industries even use them to control other machines.

Nuclear energy, an almost limitless source of power, was harnessed during the mid-1900's. Nuclear energy was first used in atomic bombs during World War II. Af-



Digital computer
1946



Polaroid Land camera
1947

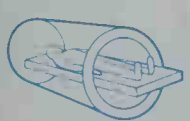
Transistor
1947

Polio vaccine
1952-1955

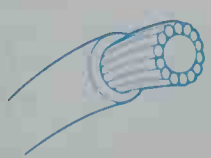
Artificial satellite
1957

Laser
1960

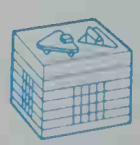
Microprocessor
1971



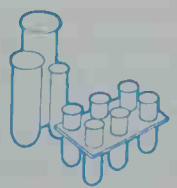
CT scanner
1972



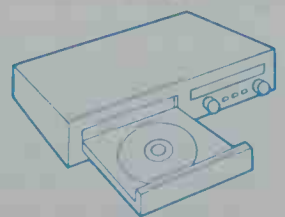
Fiber-optic cable
1970



Scanning tunneling microscope
1981



Genetic engineering
Early 1970's



Compact disc
1982

ter the war, inventors and scientists sought peaceful as well as military uses for nuclear energy. In 1956, the United Kingdom opened the world's first large-scale nuclear power station for the production of electric power, at Calder Hall in northwestern England.

During the mid-1900's, researchers developed the *solar cell,* also called the *photovoltaic cell,* to harness energy from the sun. A photovoltaic cell converts sunlight and other solar radiation to electrical energy. Engineers at the Bell Telephone Laboratories introduced an efficient photovoltaic cell in 1954. Since then, photovoltaic cells have been used to power devices ranging from handheld calculators to artificial satellites.

Recent developments. In 1960, American physicist Theodore H. Maiman demonstrated the first *laser.* A laser is a device that produces a thin, intense beam of light. The laser quickly became one of the world's most useful inventions. Lasers are of great value in such areas as communications, industry, medicine, and scientific research.

In communications, the laser is used with another invention of the mid-1900's, the *optical fiber,* a hair-thin strand of glass or plastic. In a fiber-optic communication system, special lasers transmit messages that are encoded as pulses of light through optical fibers. In 1970, Corning Glass Works produced the first optical fiber that was suitable for long-range communication. Today, a fiber-optic communication system can transmit more information than can a traditional system that sends information encoded as electrical pulses through copper wires in large cables.

Another invention that uses the laser is the compact disc (CD), first sold in Japan in 1982. Most CD's measure about 4 $\frac{3}{4}$ inches (12 centimeters) across. As a CD spins, a laser device reads a digital code recorded as tiny pits in the surface of the disc. Compact discs hold recorded music and store information for computers.

Computer technology improved rapidly beginning in the 1960's. One of the most important developments was the invention of the integrated circuit, a tiny chip of a semiconductor material, usually silicon, with built-in transistors and other electronic parts. Two Americans—Jack Kilby, an engineer, and Robert Noyce, a physicist—patented the first integrated circuits in 1959.

The invention of the integrated circuit led to the development of the *microprocessor,* an integrated circuit that can perform the arithmetic, logic, and control functions of a computer. The first microprocessors were produced in 1971 for desktop calculators. Improvements in microprocessors and integrated circuits that could store tremendous amounts of information led to smaller, cheaper computers in the 1970's. By the 1980's, many people began to use small personal computers, both in the home and in business offices.

In the 1960's, the United States government began using existing telephone lines to link its military and research computers to enable them to exchange information. By the early 1980's, many businesses had created similar computer networks. In the late 1980's, computer scientists invented ways to link the thousands of government, university, and business networks into one large network, which came to be called the Internet.

At first, the Internet carried mostly text and numerical information. But in the early 1990's, Internet experts created a system to link computer files that contain text, sounds, pictures, and moving images. This development, known as the World Wide Web, made the Internet easier and more fun to use. The Web attracted millions more computer users to the Internet.

Terry S. Reynolds

Related articles. *World Book* has hundreds of articles on separate inventions. Some of the most important inventions are described in the following articles:

Inventions in agriculture

Archimedean screw
Barbed wire
Combine
Cotton gin
Milking machine
Plow
Reaper
Threshing machine
Tractor

Inventions in communication

Alphabet
Communications satellite
Fiber optics
Motion picture
Pager
Paper
Pen
Photography
Printing
Radio
Telegraph
Telephone
Television
Typewriter
Wireless communication
Word processing

Inventions in home and family life

Air conditioning
Calculator
Cellophane
Compact disc
Electric light
Food, Frozen
Match
Microwave oven
Pin
Sewing machine
Vacuum cleaner
Videotape recorder
Zipper

Inventions in medicine

Angiography
Bronchoscope
Computed tomography
Electrocardiograph
Electroencephalograph
Endoscope
Ether
Gastroscope
Hypodermic injection
Iron lung
Magnetic resonance imaging
Manometer
Microscope
Ophthalmoscope
Positron emission tomography
Spirometer
Stethoscope
Thermography
Thermometer
Ultrasound
X rays

Military inventions

Dynamite
Gunpowder
Handgun
Machine gun
Nuclear weapon
Radar
Submarine

Inventions in science and industry

Aluminum
Bearing
Cement and concrete
Computer
Computer chip
Electric generator
Elevator
Escalator
Gasoline engine
Glass
Laser
Particle accelerator
Particle detector
Rubber
Safety lamp
Satellite, Artificial
Spinning jenny
Steam engine
Synchrotron
Telescope
Transistor

Inventions in transportation

Airplane
Airship
Automobile
Balloon
Bicycle
Gyrocompass
Helicopter
Jet propulsion
Locomotive
Ship
Steamboat

American inventors

Armstrong, Edwin H.
Baekeland, Leo H.
Baldwin, Matthias W.
Bardeen, John
Bell, Alexander Graham
Bendix, Vincent
Berliner, Emile
Brattain, Walter H.

Browning, John M.
Burroughs, William
Carver, George Washington
Colt, Samuel
Cooper, Peter
Cudahy, Michael
Curtiss, Glenn H.
Deere, John
De Forest, Lee
De Seversky, Alexander
Dixon, Joseph
Duryea brothers
Eastman, George
Edgerton, Harold Eugene
Edison, Thomas A.
Ericsson, John
Evans, Oliver
Farnsworth, Philo T.
Fitch, John
Ford, Hannibal C.
Ford, Henry
Franklin, Benjamin
Fulton, Robert
Glidden, Carlos
Goddard, Robert H.
Goodyear, Charles
Gray, Elisha
Gregg, John Robert
Hammond, John H., Jr.
Haynes, Elwood
Holland, John P.
Howe, Elias
Jefferson, Thomas
Kettering, Charles F.
Land, Edwin H.
Langley, Samuel P.
Link, Edwin A.
Maxim, Hudson
McCormick, Cyrus Hall
McCoy, Elijah
Mergenthaler, Ottmar
Morgan, Garrett A.
Morse, Samuel F. B.
Olds, Ransom E.
Otis, Elisha G.
Pullman, George M.
Pupin, Michael I.
Ritty, James
Roosevelt, Nicholas J.
Shockley, William
Sholes, Christopher L.
Singer, Isaac M.
Sperry, Elmer A.
Stanley brothers
Steinmetz, Charles P.
Taylor, Frederick W.
Tesla, Nikola
Westinghouse, George
Weston, Edward
Whitney, Eli
Woods, Granville T.
Wright brothers
Yale, Linus, Jr.
Zworykin, Vladimir K.

British inventors

Arkwright, Sir Richard
Babbage, Charles
Bessemer, Sir Henry
Cartwright, Edmund
Congreve, Sir William
Crompton, Samuel
Davy, Sir Humphry
Dunlop, John B.
Hargreaves, James
Kelvin, Lord
Macintosh, Charles
Maxim, Sir Hiram S.
Nasmyth, James
Newcomen, Thomas
Stephenson, George
Stephenson, Robert
Trevithick, Richard
Tull, Jethro
Watson-Watt, Sir Robert A.
Watt, James
Wheatstone, Sir Charles

French inventors

Coanda, Henri-M.
Coulomb, Charles A.
Cousteau, Jacques-Yves
Daguerre, Louis J.
Jacquard, Joseph M.
Laënnec, René T. H.
Lenoir, Jean J. É.
Lumière brothers
Montgolfier brothers
Niépce, Joseph N.

German inventors

Benz, Karl
Bunsen, Robert W.
Daimler, Gottlieb
Diesel, Rudolf
Gutenberg, Johannes
Maybach, Wilhelm
Siemens, Ernst Werner von
Siemens, Sir Charles William

Other inventors

Archimedes
Leonardo da Vinci
Marconi, Guglielmo
Nobel, Alfred B.

Other related articles

Agriculture
Automation
Communication
Electronics
Engineering
Industrial Revolution
Machine
Machine tool
Patent
Technology
Trademark
Transportation

Outline

I. Why people invent
A. Economic needs
B. Military needs
C. Social needs
II. How people invent
A. The inventive process
B. Research laboratories
III. The history of inventions

Questions

What was the *Norfolk system*?
What were the two most important inventions during the Renaissance?
How does invention differ from discovery?
How does invention differ from innovation?
When did science first begin to contribute significantly to the creation of inventions?
How did Charles Goodyear accidentally invent *vulcanization*?
What is the *Archimedean screw*?
What part did the steam engine play in the Industrial Revolution?
How did the invention of the *fly shuttle* lead to other inventions that helped to revolutionize the textile industry?
What are the two main challenges to human inventiveness?
What were some of the first inventions?

Additional resources

Level I

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Inverness, *IHN vuhr NEHS,* is the most important city of the Highland Region of northern Scotland. It serves as the region's commercial and administrative center. It is the chief city of the Inverness district, which has 58,849 people. Inverness lies on the River Ness in a lowland area near Loch Ness and the Moray Firth. For location, see Scotland (political map). It stands at the eastern end of the Caledonian Canal, which links the northeast and west coasts of Scotland.

Inverness lies in a scenic agricultural area. It is dominated by a castle built in the 1800's. Government agencies, tourism, and trade provide many jobs in Inverness. The city's industrial products include Scotch whisky and woolen textiles.

Archaeological evidence indicates people lived at the site of Inverness as early as about 4000 B.C. Before the mid-1700's, English and Scottish forces often fought each other at Inverness, causing much destruction there. Few of the city's buildings date from before 1800.

H. R. Jones

Invertebrate, *ihn VUR tuh briht,* is an animal that lacks a *vertebral column* (backbone). The bones of the vertebral column are called *vertebrae.* The scientific name for animals without backbones is *Invertebrata,* meaning *without vertebrae.* Animals that have vertebral columns are called vertebrates, or *Vertebrata.* There are more than 1 million known *species* (kinds) of invertebrates and about 40,000 species of vertebrates.

There are many invertebrates, and they take in many forms of animals, so they have been divided into several major groups. These groups are called *phyla.*

The phylum *Porifera* contains pore-bearing animals known as sponges. *Cnidaria* includes animals known as *cnidarians,* such as the hydra, jellyfish, Portuguese man-of-war, sea anemone, and coral. Cnidarians are characterized by having special stinging organs called *nematocysts. Platyhelminthes* takes in worms with flattened bodies, such as the planarian, liver fluke, and tapeworm. *Nematoda* is the phylum of the roundworms, such as the ascaris, pinworm, stomach worm, hookworm, and trichina (pork roundworm). *Annelida* includes worms with bodies made of segments. In this group belong the common earthworm, sandworm, and leech.

Echinodermata is a group of animals with external spines, such as the starfish, sea urchin, sand dollar, sea cucumber, and sea lily. The phylum *Mollusca* is made of the mollusks, soft-bodied animals that usually have limy shells. The snail, slug, clam, oyster, scallop, octopus, and squid belong to this group. *Arthropoda* is the largest animal phylum in number of species. It is made up of animals that have jointed legs and an outer skeleton of chitin, often like armor. They include insects, spiders, and crayfish.

The phylum *Chordata* is made up of animals that have a rather rigid structure of bone or cartilage in their backs, serving as a support. The lower chordates have a one-piece rod of cartilage in their backs and are considered invertebrates. The higher chordates have a spinal column divided into vertebrae and are vertebrates.

One of the most interesting studies in biology is tracing the way similar structures and functions develop as we pass from animal to animal through the whole animal kingdom. A person who studies the different types of animals from the lowest invertebrate to the highest vertebrate can see that similar structures and activities become more complex from the lower groups to the higher. A student of animals can also observe that all living things are constantly changing from time to time, or producing slightly different types. The theory of progressive development, or *evolution,* is based on these observations.

Lawrence C. Wit

Related articles in *World Book* include:

Amphioxus
Arthropod
Bryozoan
Chordate
Cnidarian
Deep sea (Invertebrates)
Echinoderm
Evolution
Heart (Animals without a backbone)
Insect
Mollusk
Nematode
Nervous system (In invertebrates)
Protozoan
Sponge
Vertebrate
Worm

Investment is the use of savings to produce future income. The term more specifically refers to the use of funds to acquire *capital goods.* Capital goods are items that are necessary to produce other goods and services. Examples of capital goods include factories, offices, machinery, and computers.

Many people save or invest part of their current income to consume more in the future. Some do this indirectly by letting others invest their funds, while others invest directly in their own businesses.

Investment is vital for economic development and growth. When people deposit funds in bank accounts, for example, banks lend some of those funds to business firms. The firms, in turn, use these bank loans to invest in new buildings and equipment to expand production. Many firms also raise funds for business expansion by issuing stocks and bonds that are sold to investors.

Governments issue bonds to obtain funds to invest in such projects as dams, roads, airports, and schools. All types of investments by individuals, businesses, and governments involve giving up present consumption of goods and services in the expectation of even greater consumption in the future. In this way, investment enhances a nation's ability to produce goods and services and thereby increases its standard of living.

Kinds of investments

There are two main kinds of investments: (1) direct investments and (2) indirect investments. Direct investments involve investing in a business or real estate. Indirect investments involve putting money in savings accounts or buying stocks or bonds.

Before making any investment, people should learn as much as possible about how the money they are investing will be used. People should also assess what the expected return will be from an investment. Because every investment entails *risk* (possibility of loss), one should carefully examine the expected return in relation to the risk involved. Some investments promise high returns but offer little safety. Others promise lower returns but provide almost complete safety. A person should also consider whether an investment can be *liquidated* (easily converted into cash) if an unexpected expense arises.

People should consider many types of investments, such as stocks and bonds, only if they are willing to incur the risk of losses. They should also have enough secure savings to protect themselves against any temporary loss of income resulting from illness or unemployment.

Investment terms

Dividend is a payment made by a company to its stockholders.
Face value of a bond is the amount that the company or government agrees to repay at a future date.
Income is the payment received for goods or services (see Income).
Interest is money paid by a borrower to a lender for the use of money (see Interest).
Market price of a stock is the price per share at which the stock may be purchased or sold at a particular time.
Par value is the original value of a stock or bond. This amount is printed on the security.
Premium of a bond is the difference by which the market price exceeds the face value of the bond.
Share is one of the parts into which ownership of a corporation is divided.
Stock exchange is a place where stocks and bonds are bought or sold for investors.

Direct investments. Examples of direct investments are business investments and real estate investments.

Business investments. Buying a small business may be the most demanding kind of investment. Investors may be required to work hard to earn an acceptable return. For this reason, the investor must be sure to choose the right business before making a commitment. If a person buys or opens a restaurant, for example, he or she may need to work long hours to operate it profitably.

Real estate. People invest in real estate when they buy homes, land, or rental properties. Real estate may increase in value over time and thus be sold for a profit. Real estate may also produce income directly, in the form of rent, or indirectly, in the form of crops, minerals, or timber.

Real estate may produce a higher rate of return than many other kinds of investments. Real estate is an especially good investment during periods of inflation, when property values tend to rise along with other prices. But real estate prices can fall sharply during times of recession or depression.

Investing in real estate has some major drawbacks. It typically requires a large payment at the beginning of the investment period. For most individuals, the cost of a home is several times the buyer's yearly income. Many families borrow a large portion of the purchase price of a home from a bank. Most business owners finance purchases of stores and other commercial property through a bank, pension fund, or insurance company.

Another drawback to real estate investment is that reselling property may take a considerable amount of time. In other words, such investments are low in *liquidity*—that is, the ease with which an investment can be turned into cash without loss.

Indirect investments involve funds that flow through financial institutions in such forms as savings accounts and stocks and bonds. Through these types of investments, banks and other financial institutions channel savings into loans for direct investment.

Savings accounts are a common kind of investment. Funds deposited in a savings account at a bank, credit union, or savings institution earn interest at a specified annual rate.

Most banks offer money market accounts, certificates of deposit (CD's), and other special savings plans. *Money market accounts* pay a rate of interest that reflects conditions in the *money market,* where short-term government and corporate securities are traded. Funds deposited in a *certificate of deposit* cannot be withdrawn without penalty for a specified period, such as one or two years. Both types of accounts typically pay a higher rate of interest than regular savings accounts.

Most banks and savings institutions are privately owned and operated for a profit. Credit unions, in contrast, are not-for-profit cooperative organizations operated for the benefit of members. All *net earnings* (earnings minus expenses) are passed on to members in the form of lower loan costs or higher returns on deposits.

Some types of savings accounts yield lower rates of interest than some other types of investments. Nevertheless, they attract investors with a low income or little investment experience because they involve minimal risk. In the United States, the risk is low because such accounts in almost all banks and other depository institutions are federally insured up to $100,000.

Bonds include government securities and corporate bonds. Government securities are issued by federal,

How to read a newspaper stock table

Most newspapers publish daily summaries of the stock market's activity. These reports use many abbreviations, figures, and symbols. For example, *CamSp* stands for the Campbell Soup Company and *Carnat* for the Carnation Company. The illustration below explains other figures and symbols.

Source: New York Stock Exchange (WORLD BOOK diagram)

52-week high low shows the highest and lowest prices paid for a stock in the past year.

Dividend is a stock's current annual rate of dividend payment. Dividends are shares of a company's profits that are distributed to stockholders.

Stock name, or *ticker symbol,* is the abbreviated name of the company.

52-WEEK HIGH	52-WEEK LOW	STOCK	DIV	PE	HIGH	LOW	CLOSE	CHG.
35.44	26.88	CibaSpC n	.60e	...	29.70	29.60	29.70	+ .70
11.94	3.88	CIBER		...	8.19	7.75	8.06	+ .06
35.60	25.88	CINergy	1.80	14	33.85	33.24	33.55	+ .30
24.10	7.00	Circor	.15	20	16.58	16.50	16.50	+ .07
37.50	6.69	CirCtyCC	.07	30	18.44	18.10	18.14	– .05
17.50	3.25	CirCCar		29	15.90	15.36	15.88	+ .18
25.50	21.44	CitCpIII pf	1.78	...	25.18	24.86	25.00	– .18
59.13	39.00	Citigrp s	.64f	19	50.70	48.87	49.15	+ .29
25.88	24.06	Citigp pfE	2.00	...	25.30	25.19	25.19	– .03
25.55	21.25	Citigp pfN	1.71	...	24.68	24.46	24.56	– .01
25.48	21.25	Citigp pfW	1.75	...	24.99	24.73	24.87	– .04
25.89	21.11	Citigp pfX	1.72	...	24.82	24.60	24.66	– .12
18.63	11.28	CitzComm		...	12.57	12.30	12.40	– .17
26.19	24.25	CitzCm un		...	26.02	25.60	25.94	– .20
45.00	30.75	CityNC	.74	15	43.75	42.01	42.01	– 1.03
24.94	15.63	ClairesStr	.16	13	17.55	17.30	17.46	– .09
27.00	16.88	Clarcor	.47	16	26.95	26.25	26.25	– .40
16.45	8.06	ClaytnH	.06	19	16.29	15.78	15.96	– .17
85.81	43.88	ClearChan		...	60.00	58.09	59.16	+ .21
27.25	13.69	ClvClf	.40	17	17.50	16.40	17.37	+ .69
48.63	28.38	Clorox	.84	23	35.39	34.66	34.83	+ .15
41.50	16.00	Coach n		20	41.37	39.70	40.97	+ .97
13.65	7.50	Coachmen	.20	...	12.95	12.43	12.89	+ .43
13.50	6.68	Coastcst s	.00e	10	6.72	6.50	6.60	– .08
8.00	3.31	Cobalt Cp	.05	...	7.95	7.50	7.50	– .21
64.00	42.37	CocaCl	.72	38	46.98	46.05	46.98	+ .97
23.90	15.06	CocaCE	.16	33	17.85	17.55	17.73	– .02
25.94	17.50	CCFemsa	.21e	...	21.25	20.79	20.79	– .21
2.25	.81	Coeur		...	1.19	1.10	1.11	– .04
15.50	14.92	CohStAdl n	1.26	...	15.17	14.94	14.96	– .12
14.60	11.00	CohenSTR	.96a	...	14.45	14.16	14.40	– .05
15.22	5.75	ColeNatl		51	13.65	13.30	13.65	+ .30
34.38	24.30	ColeMyr	1.50e	...	25.70	25.10	25.10	– .28
65.69	42.50	ColgPal	.72f	32	56.70	55.00	55.85	+ .64
6.65	2.88	CollAik		...	6.45	6.20	6.20	– .15

Price-earnings ratio is the price of a share divided by the company's annual earnings per share. Many investors judge the quality of a stock by its price-earnings ratio.

High and low show the highest and lowest prices paid for this stock on the previous day.

Closing price is the price of the last share sold on the previous day.

Change compares yesterday's closing price with the closing price on the day before.

state, and local governments. These investments pay interest at a specified rate over a certain period.

Savings bonds issued by the United States government are popular among investors because they are sold in small denominations and are safe. A $50 Series EE savings bond, the lowest denomination issued, costs only $25. A buyer can cash it in for the larger amount when the bond *matures* (comes due). Series EE bonds issued after May 1995 are guaranteed to mature within 17 years but may continue earning interest for up to 30 years from the date they were issued. Most savings bonds can be redeemed for cash, if necessary, after six months and pay interest rates reflecting rates paid on certain other federal securities.

People investing at least $1,000 can buy other types of United States government bonds, including Treasury bonds. These bonds are traded on stock exchanges and typically pay a higher rate of interest than savings bonds. Some of these bonds pay a fixed rate of interest. If prices were to rise unexpectedly, however, the purchasing power of these bonds would also fall.

In 1998, the U.S. Treasury began issuing *inflation-indexed bonds,* also called *I-bonds.* These bonds protect bondholders from being repaid in dollars whose value has been reduced by *inflation* (rising prices). The bonds adjust the amount investors receive to correspond to current market prices. Many other countries also offer inflation-indexed bonds, including Canada, the United Kingdom, and Israel.

The U.S. government also sells securities called *Treasury bills.* These securities are issued in denominations starting at $1,000 and mature in three, six, or nine months, much sooner than bonds do.

State and local governments issue securities called *municipal bonds.* The interest earned on these bonds is generally not subject to federal income tax. Municipal bonds therefore make attractive investments for individuals at upper income levels, who are taxed at high rates. Because of the demand created by this tax-free interest feature, such bonds typically pay lower interest rates than most federal bonds. This tax-free interest feature is limited on some municipal bonds, however, including those issued to pay for new sports facilities.

Corporate bonds represent loans made to business firms by investors. A firm pays its bondholders interest every year until the bonds mature. At that time, the firm redeems the bonds by paying bondholders their face value. In most cases, this amount is $1,000 per bond. If a firm *defaults* (fails to meet its financial obligations), the bondholders have the legal right to take over the firm and sell any assets pledged as security on the bonds.

The prices of bonds issued by corporations or by governments may change due to fluctuations in market interest rates. As a result, investors may fail to get back the full purchase price of their bonds if they sell them before maturity. In addition, investors may suffer losses if business firms or governments default.

Stocks include two types of corporate securities: (1) common stock and (2) preferred stock.

Common stock represents shares of ownership in a company. The stockholders of a firm share in its profits. They also share in the losses, but only to the extent of their investment. If a business firm has a profitable year, the stockholders may receive cash dividends. The exact rate of return on any common stock depends on its dividend and the price at which it trades in the market. If a firm suffers financial losses during a year, it may not pay a dividend, and its stock price may even decline.

A company may also decide to use its profits to expand its operations rather than to pay dividends. Some stockholders may not object to such a strategy as long as the firm's stock price rises. *Appreciation* (increase in the value) of a stock represents a *capital gain.* Capital gains are the profits earned from the sale of stocks, real estate, or other income-producing property.

Preferred stock is a type of corporate security that has features of both bonds and common stock. Like corporate bonds, preferred stock promises a fixed rate of return. The corporation must pay this return before it distributes any dividends to investors in common stock. Thus, preferred-stock holders face less risk than common-stock holders. Unlike bond owners, however, preferred-stock holders have no legal right to force a corporation to pay them the promised annual returns if the firm has insufficient earnings to do so.

Both common and preferred stocks can yield higher returns than bonds. Over long periods, the return on stocks has consistently exceeded the return on bonds and other types of investments. Stocks are riskier than bonds, however. As a result, investors cannot be sure that stocks will always outperform bonds. Also, the prices of individual stocks change constantly and often by large amounts. An economic slump or poor earnings at a particular firm can produce an unfavorable market reaction in all stock prices or in an individual stock price. For this reason, many individuals make an effort to buy both stocks and bonds.

Other kinds of indirect investments provided by financial institutions include mutual funds and life insurance policies.

Mutual funds are companies that invest in a variety of securities and sell shares in those securities to all types of investors. They offer some advantages to individual investors. For example, mutual funds employ specialists who select specific stocks or bonds that they consider most likely to meet the goals of a fund, such as capital appreciation or low risk. Mutual funds also permit investors to own securities in a large number and wide variety of business firms. This concept is called *diversification.* Diversification reduces the overall risk of loss to investors because losses incurred by one firm may be offset by profits earned by another.

The cash dividends that mutual funds pay to their shareholders are generally taxable. Shareholders may automatically reinvest these dividends in additional shares of the mutual fund.

Most mutual funds are *open-end funds.* In this type of fund, investors can buy or sell shares whenever they wish. Open-end funds must buy back their shares for their approximate *net asset value.* This amount reflects the current market value of all the securities or assets of the fund. In a *closed-end fund,* a fixed number of shares are bought and sold on stock exchanges, usually at a price below the net asset value.

Some mutual funds are called *money market funds* and invest only in government and corporate short-term securities. These funds provide an alternative to the savings accounts offered by banks. Money market funds

usually pay higher rates of interest than bank savings accounts because they operate without all the expenses of traditional banks. Most money market funds, moreover, allow investors to write checks against their investment in the funds. Because money market funds only make short-term investments, there is relatively little variation in net asset value. As a result, such funds are highly liquid. In the United States, however, investors putting their money into mutual funds are not protected against loss by a federal insurance program.

Life insurance policies. Life insurance companies sell insurance policies that also act as a savings account. A person typically buys life insurance to provide financial protection for family members in the event of death. Many types of life insurance, however, include a savings provision. An insurance company sets aside part of each *premium* (insurance payment) paid after a policy has been in force for a certain period. This amount, called the *cash value* of the policy, accumulates and earns a specified rate of interest. In this way, it resembles a savings account. The cash value of an insurance policy may be particularly useful in an emergency involving an unplanned expense. Policyholders can terminate their life insurance for the cash value or keep the policy and borrow against its cash value.

How investors buy stocks

Many people who buy stock place their order with a brokerage company. A broker may fill the order by buying the desired shares from dealers or investment banks that sell newly issued securities. The broker may also relay the order to a representative at a stock exchange where stocks are traded. The representative then carries out the requested transaction. The investor pays the purchase price of the shares, plus a commission for the broker's services. Brokers also sell stocks for investors.

In the late 1990's and early 2000's, many investors began buying and selling stocks electronically through computers, a method of investing called *online investing*. Online investing, which is also called electronic trading or e-trading, became more common as the Internet, a worldwide network of computers, began to grow in popularity. Individuals who invest online have more control over their investments than do people who invest through traditional brokers. They can access their brokerage accounts virtually anytime and from anywhere in the world. Most online brokerage services charge lower commissions than traditional brokerage firms charge. The online services can operate more cheaply because they have eliminated many expenses, such as those of a large staff and office space.

James R. Barth and Lalita Ramesh

Related articles in *World Book* include:

American Stock Exchange
Bond
Certificate of deposit
Commercial paper
Credit union
Federal Deposit Insurance Corporation
Federal Reserve System
Inflation (Effects on investment)
Interest
Investment banking
Money market fund
Mutual fund
Real estate
Savings and loan association
Savings bond
Securities and Exchange Commission
Securities Exchange Act
Stock, Capital
Stock exchange
Trust fund

Additional resources

Karlitz, Gail, and Honig, Debbie. *Growing Money.* Price Stern, 1999. Younger readers.
Malkiel, Burton G. *A Random Walk down Wall Street* 7th ed. Norton, 1999.
Rosenberg, Jerry M. *Dictionary of Investing.* Rev. ed. Wiley, 1993.
Slatter, John. *Straight Talk About Stock Investing.* McGraw, 1995.

Investment banking is a business activity in which a company purchases newly issued securities, such as stocks and bonds, from businesses and governments. Such a company, called an investment bank, resells the securities to investors in smaller quantities. Thus, the investment bank helps large borrowers raise money quickly and efficiently by taking over much of the job of marketing the stocks and bonds being issued. Without investment banks, businesses that lack experience in doing so would have to market their own securities.

Investment bankers also advise businesses in arranging corporate mergers and acquisitions. Investment banks do not accept deposits from the public or make loans to businesses or individuals.

Investment banks buy securities at a slightly lower price than they expect to sell them for. The difference between the purchase and sale prices represents profit. Sometimes, however, the investment bank overestimates the demand for the securities it buys, and must sell them at a loss. Thus, the investment bank assumes the risk of making or losing money on the sale of securities. To avoid this risk, a business or government sells its securities to the investment bank for less than it might get by selling them directly to investors.

In the United States, the Securities Exchange Acts of 1933 and 1934 established minimum standards of disclosure to protect the public from investing in unsafe securities. The 1934 act set up the Securities and Exchange Commission to enforce the new rules. Through the years, the U.S. Congress has provided more protection for investors. Carol S. Greenwald

See also **Investment; Securities and Exchange Commission; Stock, Capital; Stock exchange.**

Invisible ink is a writing fluid intended for secret communication. The invisible writing is developed by heat or a chemical. Milk, whey, sugar solutions, or any colorless vegetable juice may be used as invisible ink. These fluids turn brown when exposed to heat not quite high enough to damage the paper.

Many pairs of chemicals are also used as invisible ink. One chemical is used for writing and the other for developing. For example, marks made with a dilute solution of potassium ferrocyanide or tannic acid can be developed by dipping the paper in a dilute solution of ferric chloride or ferric alum.

Scientists can easily detect secret writing. Photography with infrared or ultraviolet light often reveals invisible ink.

Invitations. See **Etiquette** (Invitation etiquette); **Letter writing** (Formal invitations; Informal invitations; illustrations).

Invoice. See **Bill** (In commerce).

Io, *EYE oh,* in Greek mythology, was a mistress of the god Zeus. Soon after Zeus became the ruler of the universe, Io was changed into a beautiful white cow. One myth tells that Zeus transformed Io to disguise her from his jealous wife, Hera. According to another myth, Hera

Detail of *Juno Confiding Io to the Care of Argus* (about 1660), an oil painting on canvas by Claude; National Gallery of Ireland, Dublin

Io was changed into a beautiful white cow after becoming Zeus's mistress. Zeus's jealous wife Hera (Juno in Roman mythology) gave Io to Argus, to guard her from Zeus.

transformed Io to punish her and to break up her love affair with Zeus.

Hera sent a gadfly to torment Io and ordered Argus, a huge monster with 100 eyes, to guard her from Zeus. Hermes, the messenger of the gods, killed Argus, but the gadfly continued to torment Io and pursued her over the earth. She finally found peace in Egypt, where Zeus changed her back into a woman. In Egypt, Io gave birth to a son, Epaphus, the ancestor of many mythological kings and of the hero Hercules. Io was often identified with the Egyptian goddess Isis. Justin M. Glenn

Io, *EYE oh,* is a large moon of Jupiter that is more geologically active than any other satellite—or any planet—in the solar system. Its surface is covered with recent lava flows and more than 200 large volcanic depressions. Many of its volcanic eruptions resemble those of geysers. In these eruptions, sulfur and sulfur dioxide gases, heated by contact with volcanic rock, shoot into space. The gases sometimes reach altitudes of hundreds of miles or kilometers. There, the gases form umbrella-shaped plumes and produce a sulfurous "snow."

NASA

Io, a moon of Jupiter, is the most colorful satellite in the solar system. Sulfur gases erupt from Io's volcanoes, then drift to the surface as colored "snow." Sulfur dioxide settles as a white frost.

Sulfur that has settled or flowed onto the surface makes Io the most colorful satellite in the solar system. The sulfur creates a rich array of yellows, greenish-yellows, and oranges, along with gray and black. The satellite has a large, iron-rich core that is probably liquid, a thick layer of dense rocks, and a crust of lighter rocks and sulfur compounds. Its thin, patchy atmosphere consists mainly of sulfur dioxide above volcanoes.

The high temperature on Io's surface during the day is about −260 °F (−160 °C). The erupting lava may be hotter than 3100 °F (1700 °C). Io's heat comes from the gravitational forces of Jupiter and its other large satellites. These forces pull Io's interior in different directions. As a result, the interior flexes, producing heat.

Io is 2,256 miles (3,630 kilometers) in diameter, about 5 percent wider than Earth's moon. Io orbits Jupiter in 1.77 days at a distance of 262,000 miles (421,600 kilometers). The Italian astronomer and physicist Galileo discovered Io in 1610. William B. McKinnon

See also **Jupiter; Satellite.**

Iodine is a nonmetallic chemical element. It is a member of the *halogen* family of elements. The other halogens are astatine, bromine, chlorine, and fluorine. See **Halogen.**

At ordinary temperatures, iodine is a shiny bluish-black solid with an irritating odor. When heated, it usually *sublimes*—that is, it changes from a solid directly into a vapor. Iodine vapor is purple. The word iodine comes from a Greek word meaning *purple.*

Uses of iodine. Plants and animals need traces of iodine for normal growth. In the human body, the thyroid gland, which is located in the neck, uses iodine to produce the hormone *thyroxine.* Thyroxine controls the body's rate of physical and mental development. Iodine deficiency can hinder growth and can also produce *goiter,* an enlargement of the thyroid gland. For these reasons, manufacturers add small amounts of potassium iodide or sodium iodide to table salt in areas where iodine levels in food and water are low. Pure iodine is poisonous if swallowed.

Iodine and its compounds have important commercial uses. For example, silver iodide serves as the principal light-sensitive substance in photographic film. Commercial bakers use another compound, sodium iodate, to improve the quality of bread made from certain kinds of flour. Iodine and iodine compounds are used in purifying water and as disinfectants. For many years, people have used a solution of iodine in alcohol, called *tincture of iodine,* as a first-aid antiseptic. But this solution can irritate wounds. As a result, instead of tincture of iodine, many people now use more complex iodine compounds called *iodophors.*

Sources of iodine. The chief source of iodine is *brine* (very salty water) that contains sodium iodide and potassium iodide. Such brine is obtained from wells in petroleum fields and natural gas fields. Another source of iodine is the mineral *lautarite,* in which iodine forms the compound calcium iodate. Lautarite is found chiefly in nitrate deposits in Chile.

Properties of iodine. Iodine has the chemical symbol I. Its atomic number is 53, and its atomic weight is 126.90447. The element melts at 113.60 °C and boils at

185.24 °C. It was discovered by the French chemist Bernard Courtois, who found it in the ashes of burnt seaweed in 1811. In 1814, the French chemist Joseph L. Gay-Lussac became the first person to recognize iodine as a chemical element. Evan H. Appelman

See also Element, Chemical (tables).

Ion, *EYE uhn* or *EYE ahn,* is an atom or a group of atoms that has an electric charge. Atoms and molecules become charged if they gain or lose electrons. Each atom has a cloud of negatively charged electrons around a small, heavy nucleus. The nucleus contains positively charged protons. If the number of electrons around the nucleus equals the number of protons inside the nucleus, the atom is neutral. The process of removing electrons from atoms or molecules to produce positive ions is called *ionization.* The electrons removed may then join other atoms or groups of atoms, causing them to become negative ions. The amount of electric charge an ion has is determined by the number of electrons gained or lost by the atom or molecule.

Many common substances contain ions. For example, table salt consists of equal numbers of positively charged sodium ions and negatively charged chloride ions. In forming table salt from the elements sodium and chlorine, each sodium atom loses an electron and becomes a positive sodium ion. Likewise, each chlorine atom gains an electron and becomes a negative chloride ion. Seawater contains many kinds of ions. The most common ones, in order of their amount, are chloride, sodium, sulfate, and magnesium. The earth's atmosphere also contains ions. They are concentrated in a layer called the *ionosphere.*

Ions in solids usually fit together in a regular, repeating, three-dimensional arrangement. Such a substance is called an *ionic crystal.* For example, sodium ions alternate with chloride ions in a crystal of table salt. Ions in an ionic crystal are held together by *electrostatic attraction,* the attraction between opposite charges.

Ions in liquids can migrate throughout the liquid. In a solution, each ion attracts one or more molecules of the *solvent* (dissolving liquid). Ionic crystals, such as sodium chloride, usually dissolve only in solvents that contain *polar* molecules. Polar molecules have a positive end and a negative end. Each ion on the surface of the crystal attracts the oppositely charged end of polar molecules. This attraction weakens the attraction between ions in the crystal. The ions then break away from the crystal and enter the solution, combined with polar molecules. Ions combined with polar molecules of the solvent are said to be *solvated.*

Ions in gases are too far apart at normal pressures to attract each other strongly. As a result, single ions in a gas may drift for a long time before they combine with other ions. A mixture consisting of ionized gas and electrons is called a *plasma.*

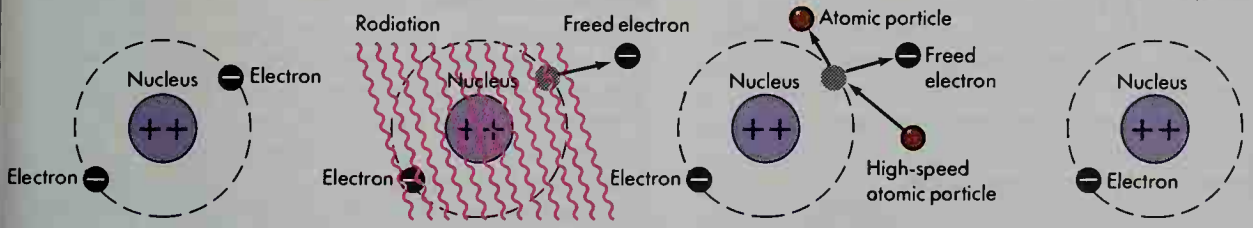
Many particles in space are ions. Some of these ions are trapped by the earth's magnetic field and make up part of the Van Allen belt.

Behavior of ions. All ionic solids and liquids, and most ionized gases, are electrically neutral. The total charge of all their positive ions equals the total charge of all their negative ions. This general rule also applies to all other kinds of matter, and is called the *principle of electroneutrality.*

Like neutral atoms and molecules, ions in a liquid or a gas are constantly moving. Each one changes its direction of motion billions of times each second because of collisions and the forces exerted on it by other particles. After each change in direction, an ion usually is no more likely to be moving in one direction than in any other.

Gaseous ionization

WORLD BOOK illustrations by Bensen Studios, Inc.



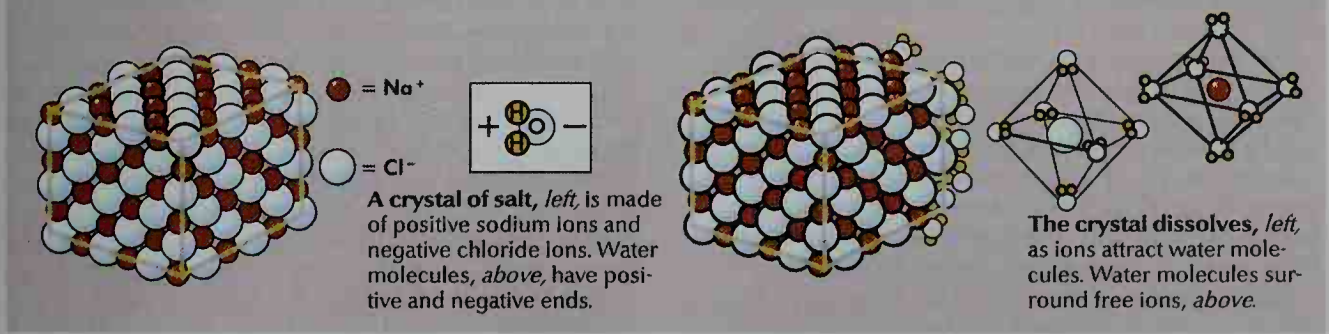
A helium atom, *shown here,* becomes a positively charged ion when it loses one or both of its negative electrons.

The ionization of helium occurs when an electron is freed from the neutral atom. The energy needed to free the electron can come from several sources, including electromagnetic radiation, *at left,* and high-speed atomic particles, *at right.*

The helium ion that remains, *shown here,* has only one electron. As a result, the ion has a positive electric charge.

Dissolving an ionic crystal

WORLD BOOK illustrations by Bensen Studios, Inc.



A crystal of salt, *left,* is made of positive sodium ions and negative chloride ions. Water molecules, *above,* have positive and negative ends.

The crystal dissolves, *left,* as ions attract water molecules. Water molecules surround free ions, *above.*

Such random motion is called *Brownian motion.* When two oppositely charged electrodes are placed in a liquid or gas, each ion loses part of its random motion and starts to drift toward one of the electrodes. Negative ions drift toward the *anode* (negative electrode) and are called *anions.* Positive ions drift toward the *cathode* (positive electrode) and are called *cations.* The movement of the charges carried by the drifting ions makes up an electric current.

The ability of a solution to conduct electric current depends on the concentration of ions in the solution. For example, drinking water drawn from a typical municipal treatment plant in the United States contains few ions and therefore is a poor conductor of current. But seawater, with significant amounts of dissolved sodium chloride, magnesium sulfate, and other ionic compounds, is a good conductor.

Producing ions. Any process that can add or remove electrons from an atom or a molecule can produce ions. Radiation and chemical reactions are such processes. Radiation can increase the energy of the electrons in an atom. If this energy is increased enough, one or more electrons can overcome the attraction of the nucleus and escape from the atom. The atom thereby becomes a positive ion. Radiation that can produce ions includes ultraviolet rays, X rays, gamma rays, atomic nuclei, subnuclear particles, and electrons.

High-energy radiation absorbed by plant or animal tissues produces unnatural ions in the tissues. These ions become involved in potentially harmful chemical reactions. In human beings and other animals, the symptoms of these reactions are called *radiation sickness.* The amount of radiation absorbed by tissues is measured in *rads.* One rad corresponds to the formation of more than a billion pairs of ions in the tissues. Death is likely to occur if a person absorbs about 500 rads over a short period. In the metric system, the unit of absorbed dose is the *gray,* which equals 100 rads.

Ions are formed in a chemical reaction if molecules split into electrically charged parts. For example, molecules of hydrogen chloride (HCl) split when added to water. They form positive hydrogen ions and negative chloride ions. Peter A. Rock

Related articles in *World Book* include:

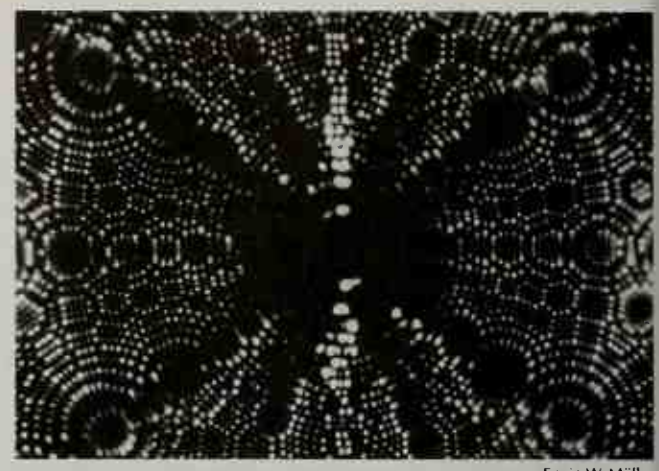
Atom	Ionosphere	Radiation
Electricity (Ions)	pH	Van Allen belts
Electrolysis	Plasma (physics)	

Ion microscope, also known as a *field-ion microscope,* is one of the most powerful magnifying instruments in scientific use. It magnifies with such sharpness that individual atoms may be seen. Scientists use it to study metals and alloys. They use it to learn how metal atoms are arranged to form crystals and how gases and radiation affect such crystals.

The main part of an ion microscope is a thin needle made of the metal to be examined. This needle is 1,000 times sharper than the tip of an ordinary pin. It points toward a fluorescent screen positioned nearby. When the microscope is in operation, the screen shows an enlarged image of the tip of the needle. This image is a pattern of bright dots. These dots show the arrangement of the metal atoms that form the needle's tip.

The ion microscope works on the principle of electrical attraction and repulsion. The needle and screen are enclosed in an airless glass tube that contains a small amount of helium, neon, or argon gas. An electric field of up to 30,000 volts is established between the needle and the screen. The needle receives a positive charge, and the screen becomes negatively charged. The needle attracts electrons, which are negatively charged, from gas atoms that drift near its tip. When the gas atoms lose electrons, they become positively charged ions. Because of their charge, the ions are repelled from the atoms that form the tip of the needle. The ions fly directly to the screen. Wherever they strike the screen, they cause it to glow. As the ions stream from the needle, they fan out to cover the screen. They create a magnified image of the needle tip, showing the arrangement of the atoms in the crystal. The ion microscope was invented in 1951 by Erwin W. Müller (also spelled Mueller), a German physicist who moved to the United States that year.

John B. Sharkey



Erwin W. Müller

Ion microscope photograph shows arrangement of atoms (tiny white dots) in a tungsten crystal, magnified 713,000 times.

Ionesco, Eugène (1909-1994), was a Romanian-born French playwright. His unconventional plays often are filled with decaying or lifeless objects that grow until they suffocate the human characters. Many of his characters seem to have lost their power to think, and they act like robots. Since they speak in trite phrases, their words have lost their main function of communication.

In *The Bald Soprano* (1950) and *The Chairs* (1952), married couples symbolize the absurd qualities of life as Ionesco saw them. *The Lesson* (1951) depicts the use of language as an instrument of power and torture. *The Killer* (1958), *Rhinoceros* (1959), and *A Stroll in the Air* (1963) contain a character named Bérenger who, isolated from the rest of humanity, faces as best he can the cruelties of life. Ionesco published six short stories and part of an autobiography in *The Colonel's Photograph* (1962). His *Notes and Counternotes* (1962) expresses his ideas on theater and on writing plays.

Ionesco was born in Slatina, Romania. He became a permanent resident of France in 1938. He was elected to the French Academy in 1970. Dora E. Polachek

Ionian Islands, *eye OH nee uhn,* are a group of islands in the Ionian Sea that are part of Greece. The group consists of four large islands and many small islands. They lie off the west coast of mainland Greece. They have a total land area of 891 square miles (2,307 square kilometers) and a population of about 195,000.

The Ionian Islands lie in the Ionian Sea, off the west coast of the mainland of Greece. They include four large islands—Corfu, Leucas, Cephalonia, and Zante—and many smaller islands.

WORLD BOOK maps

The four large islands of the Ionian group are Corfu (or, in Greek, Kerkira), Leucas (Levkas), Cephalonia (Kefallinia), and Zante (Zakinthos). More than half of the people live on Corfu. The islands are hilly and have lush, green vegetation. The climate is wet and mild in winter, and dry and hot in summer.

Agriculture and tourism rank as the chief economic activities of the Ionian Islands. The main farm crops are grains, olives, and grapes. Tourist attractions include historic buildings and such water sports as sailing, fishing, and skin diving. The islands have little industrial activity except for textile production and food processing.

The Ionian Islands were first settled in the Stone Age, before 10,000 B.C. The islands figured prominently in the *Odyssey*, an ancient epic poem attributed to the Greek poet Homer. According to the poem, Ithaca (Ithaki), one of the small Ionian islands, was the home of Odysseus (called Ulysses in Latin), the hero of the story. The islands played an active role in the social and political life of ancient Greece. They came under Roman rule about 200 B.C. When the Roman Empire split into two parts in A.D. 395, the islands remained under the East Roman, or Byzantine, Empire. Beginning in the 1300's, Venice gradually took control of them. The islands were an important part of Venice's colonial empire until 1797, when the Venetian Republic fell. France then began ruling them.

Britain took over the islands in 1815. The British built roads and improved the educational system. British rule ended in 1864, and the islands became part of Greece.

A shortage of jobs is a major problem in the islands. Through the years, many people have left the islands to try to find jobs. Since 1926, the population has declined by about 100,000. John J. Baxevanis

Ionian Sea, *eye OH nee uhn,* is the deepest part of the Mediterranean Sea. It separates Italy and Sicily from Albania and Greece. The Strait of Otranto connects it with the Adriatic Sea. The Gulf of Corinth is the largest of many deep inlets formed by the Ionian Sea on the coast of Greece. The Ionian Islands lie in the eastern part of the sea. Its greatest width is about 420 miles (676 kilometers), and its greatest depth is 16,302 feet (5,093 meters). For location, see Greece (terrain map). The sea was named after the Greek nymph Io, who supposedly wandered along its shores. John J. Baxevanis

Ionians, *eye OH nee uhnz,* were a group of ancient Greeks. They lived in various parts of the *Peloponnesus* (the southern peninsula of Greece) before 1100 B.C. Other Greeks called Dorians invaded the Peloponnesus toward the end of the 1100's. To escape the invaders, many Ionians fled east to the section of Greece called Attica. Some of these Ionians became ancestors of people who lived in Athens when it developed into a great city-state in Attica. Other Ionians sailed across the Aegean Sea and occupied *Ionia,* a region along the western coast of Asia Minor (present-day Turkey).

The people of Ionia organized a confederacy of 12 independent cities. The cities included Ephesus, with its Temple of Artemis; and Miletus, birthplace of some early Greek philosophers. The Ionians were the cultural leaders of the Greeks in the 600's and 500's B.C. They originated Western literature and philosophy.

King Croesus of Lydia conquered Ionia in the mid-500's B.C. The Persians conquered it about 545 B.C. In the early 400's B.C., Ionia became free of Persian rule and allied itself with Athens. In 404 B.C., Sparta and its allies defeated Athens in the Peloponnesian War. Ionia again fell under Persian rule. Alexander the Great freed Ionia in the late 300's B.C. But first his successors and then the Romans dominated Ionia politically. Norman A. Doenges

See also Aegean civilization; Aeolians; Dorians; Greece, Ancient (History).

Ionization. See Ion.

Ionization detector. See Smoke alarm.

Ionosphere, *eye AHN uh sfeer,* is a part of the earth's atmosphere that has many *ions* (electrically charged atoms and groups of atoms) and free electrons. Cosmic rays and radiation from the sun produce these ions. The ionosphere extends through the layers of the atmosphere known as the *mesosphere* and the *thermosphere.*

Several ionized regions make up the ionosphere. The lowest one, called the D region, begins at an altitude of 34 to 55 miles (55 to 89 kilometers). The E region has an altitude of 55 to 90 miles (89 to 145 kilometers). The F region begins at 90 miles (145 kilometers) and extends up to about 190 miles (306 kilometers). The height and ionization of these regions vary from day to night and with changes in solar radiation. For example, the D region almost disappears at night. The other regions rise and become less strongly ionized at night because no solar radiation reaches the atmosphere.

The ionosphere makes long-distance radio communication possible because it reflects certain radio waves thousands of miles back to the earth. At night, when the regions of the ionosphere rise, radio waves can be received even farther from the transmitter than during the day. Veerabhadran Ramanathan

See also Air; Radio (Transmitting radio waves); Appleton, Sir Edward Victor.

I.O.U. The words *I owe you* sound like the letters *I O U.* These letters serve as a brief form of that statement. People call a declaration or memorandum of debt an I.O.U. The usual wording is as follows:

Chicago, January 1, 2000

To Julie Brown. I.O.U. $10.00.

Thomas Brown

An I.O.U. includes no promise to pay, so it is not considered a promissory note. It serves as strong, but not definite, legal evidence of debt. Joanna H. Frodin

Grant Heilman

A field of golden corn on an Iowa farm creates a picturesque rural landscape. Farms cover nearly 95 per cent of Iowa's land. The chief crops raised in the state are corn and soybeans.

Iowa *The Hawkeye State*

Iowa, *EYE uh wuh,* is one of the greatest farming states in the United States. It is sometimes called the *Corn State* and is known as "the land where the tall corn grows." Iowa produces about a fifth of the corn grown in the United States—more than any other state.

The pioneers who plowed the prairie sod of Iowa uncovered deep layers of rich soil. They made the grass-covered plains of Iowa bloom with vast fields of crops. Today, farms make up about 93 per cent of the state's area. Approximately 10 per cent of the people of Iowa live on farms.

Iowa farmers provide about 7 per cent of the nation's food supply. The chief crops raised in the state are corn and soybeans. Iowa leads the states in the number of hogs raised for marketing—about a fourth of the country's total. Iowa also ranks among the leading producers of beef cattle, milk, and oats.

Many manufacturing industries of Iowa serve the state's agriculture. The most important manufacturing activity is food processing, particularly the processing of corn and pork products. Next in importance among manufacturing activities is the production of machinery, especially farm machinery.

The contributors of this article are Robert E. Clark, Assistant Professor of Geography at the University of Northern Iowa; and Malcolm J. Rohrbough, Professor of History at the University of Iowa.

In 1960, for the first time in Iowa's history, the U.S. census reported that more Iowans lived in urban areas than in rural areas. Opportunities in manufacturing and service industries in cities had caused people to move away from farms. Service industries have continued to grow since that time, and they now employ about two-thirds of the state's workers. Des Moines, Iowa's capital and largest city, has become a national center of the insurance industry. Other important service industries in Iowa include wholesale and retail trade, and health care.

Iowa has produced many famous people. Herbert Hoover, the 31st President of the United States, was born in West Branch. Henry A. Wallace, who served as Vice President of the United States under President Franklin D. Roosevelt, was from Iowa. Carrie Chapman Catt, an Iowa educator, became a leader in the woman-suffrage movement. Grant Wood's paintings of rural Iowa have won fame throughout the world. Iowan Norman E. Borlaug received the 1970 Nobel Peace Prize for helping increase food production in developing countries.

Iowa's most famous nickname is the *Hawkeye State.* This nickname probably honors Black Hawk, a famous Indian chief. Black Hawk led a group of Sauk and Fox Indians against the whites in the Black Hawk War of 1832. The Indians were defeated and gave up a strip of land along the Mississippi River. This land was known as the Black Hawk Purchase. In 1833, permanent settlements began there.

Interesting facts about Iowa

"Go West, young man, go West and grow up with the country!" was Horace Greeley's famous advice to Josiah Bushnell Grinnell in 1853. A year later, Grinnell, a Congregationalist minister, left New York City. He settled on a prairie between the Iowa and Skunk rivers and established the town of Grinnell.

The Pottawattamie County jail in Council Bluffs was a unique three-story prison sometimes referred to as "the human squirrel cage" or "lazy Susan jail." Pie-shaped cells at the jail rotated around a central core. The core had only one opening on each floor. Once a prisoner entered a cell from the core, the cell was rotated by a crank, leaving the cell completely sealed off. The structure was used as a jail from 1885 until 1969. It has since been restored and is open for viewing by the public.

"Human squirrel cage"

WORLD BOOK illustrations by Kevin Chadwick

Shortest railroad

The shortest and steepest railroad in the United States is located in Dubuque. The track is 296 feet (90 meters) long and rises at an incline of 60 degrees to a height of 189 feet. The railroad was built in 1882 by a local banker, J. K. Graves. It still operates today and is called the Fenelon Place Elevator.

The red Delicious apple, the top-selling apple in the United States, was developed on an orchard near East Peru. Shoots from the stump of a stray apple tree began producing fruit on Jesse Hiatt's orchard in the 1880's. Hiatt entered the new variety, which he called the "Hawkeye" apple, in an apple contest and won. In 1895, Stark Brothers Nursery purchased rights to the apple, renaming it *Delicious.* Offshoots of the original tree still produce apples on the same site.

T. Blank, FPG

Downtown Des Moines rises along the Des Moines River in south-central Iowa. Des Moines is the capital, largest city, and chief manufacturing center of the state.

Bix Beiderbecke Memorial Society

The Bix Beiderbecke Memorial Jazz Festival takes place in Davenport each July. Bix Beiderbecke, a famous jazz musician, was born in Davenport.

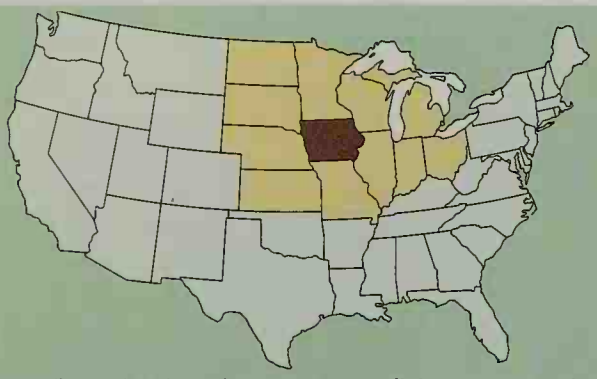
Iowa in brief

Symbols of Iowa

The state banner, adopted in 1921, bears a reproduction of the eagle from the state seal carrying a streamer with the state motto. On the seal, adopted in 1847, a soldier holds an American flag in his right hand and a gun in his left hand. Symbols of agriculture include a plow, a sheaf of wheat, and a sickle. To the soldier's right are a pile of pig lead and a lead furnace. The Mississippi River flows in the background.

State banner

State seal



Iowa (brown) ranks 25th in size among all the states and 9th in size among the Midwestern States (yellow).

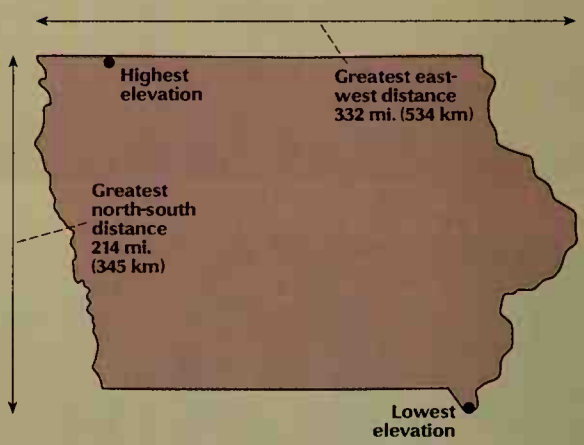
The State Capitol is in Des Moines, Iowa's capital since 1857. Earlier capitals were Burlington (1838-1841) and Iowa City (1841-1857).

General information

Statehood: Dec. 28, 1846, the 29th state.
State abbreviations: Ia. (traditional); IA (postal).
State motto: *Our Liberties We Prize and Our Rights We Will Maintain.*
State song: "The Song of Iowa." Words by S.H.M. Byers; sung to the tune of "Der Tannenbaum."

Land and climate

Area: 56,276 sq. mi. (145,754 km²), including 401 sq. mi. (1,038 km²) of inland water.
Elevation: *Highest*—1,670 ft. (509 m) above sea level along the north boundary of Osceola County. *Lowest*—480 ft. (146 m) above sea level at the junction of the Mississippi and Des Moines rivers in Lee County.
Record high temperature: 118 °F (48 °C) at Keokuk on July 20, 1934.
Record low temperature: −47 °F (−44 °C) at Elkader on Feb. 3, 1996.
Average July temperature: 75 °F (24 °C).
Average January temperature: 19 °F (−7 °C).
Average yearly precipitation: 32 in. (81 cm).



Important dates

1673 — Marquette and Jolliet became the first white people to land on Iowa soil.

1788 — Julien Dubuque, Iowa's first settler, began mining lead near present-day Dubuque.

1803 — The United States acquired Iowa in the Louisiana Purchase.

1846 — Iowa became the 29th state on December 28.

State bird
Eastern goldfinch (American goldfinch)

State flower
Wild rose

State tree
Oak

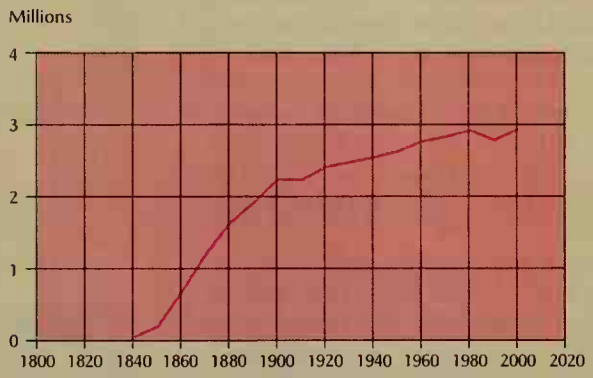
People

Population: 2,926,324 (2000 census)
Rank among the states: 30th
Density: 52 per mi² (20 per km²), U.S. average 78 per mi² (30 per km²)
Distribution*: 61 percent urban, 39 percent rural
Largest cities in Iowa

Des Moines	198,682
Cedar Rapids	120,758
Davenport	98,359
Sioux City	85,013
Waterloo	68,747
Iowa City	62,220

Source: 2000 census, except for *, where figures are for 1990.

Population trend



Source: U.S. Census Bureau.

Year	Population
2000	2,926,324
1990	2,787,424
1980	2,913,808
1970	2,825,368
1960	2,757,537
1950	2,621,073
1940	2,538,268
1930	2,470,939
1920	2,404,021
1910	2,224,771
1900	2,231,853
1890	1,912,297
1880	1,624,615
1870	1,194,020
1860	674,913
1850	192,214
1840	43,112

Economy

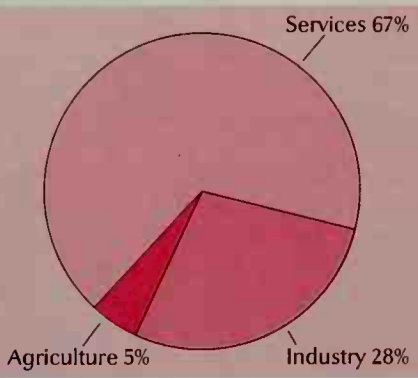
Chief products

Agriculture: corn, hogs, soybeans, beef cattle, poultry, milk.
Manufacturing: food products, machinery, chemicals, fabricated metal products, electrical equipment.
Mining: Limestone, sand and gravel.

Gross state product

Value of goods and services produced in 1998: $84,627,000,000. *Services* include community, business, and personal services; finance; government; trade; and transportation, communication, and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, fishing, and forestry.

Source: U.S. Bureau of Economic Analysis.



Government

State government

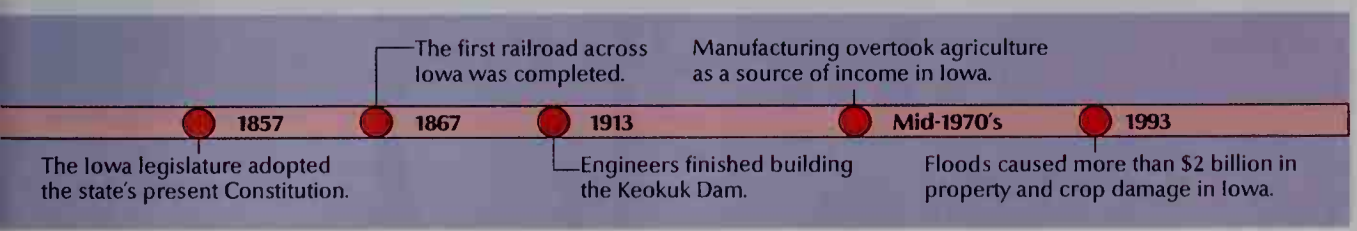
Governor: 4-year term
State senators: 50; 4-year terms
State representatives: 100; 2-year terms
Counties: 99

Federal government

United States senators: 2
United States representatives: 5
Electoral votes: 7

Sources of information

For information about tourism, write to: Iowa Department of Economic Development, Division of Tourism, 200 E. Grand Avenue, Des Moines, IA 50309. The Web site at www.traveliowa.com also provides information.
For information on the economy, write to: Public Information Office, General Assembly, State Capitol, Des Moines, IA 50319.
The state's official Web site at www.state.ia.us also provides a gateway to much information on Iowa's economy, government, and history.



Population. The 2000 United States census reported that Iowa had 2,926,324 people. The state's population had increased 5 $\frac{1}{2}$ percent from the 1990 census figure, 2,776,755. According to the 2000 census, Iowa ranks 30th in population among the 50 states.

About 45 percent of the population lives in the state's metropolitan areas. Iowa has eight Metropolitan Statistical Areas located entirely or partly within the state (see **Metropolitan area**). For the names and populations of the metropolitan areas, see the *Index* to the political map in this article.

Iowa has nine cities with populations of 50,000 or more. The largest of these cities is Des Moines, which is also the state capital. Des Moines is located close to the center of the state. Iowa's next largest cities, in order of population, are Cedar Rapids, Davenport, Sioux City, Waterloo, Iowa City, Council Bluffs, Dubuque, and Ames.

About two-fifths of the people of Iowa live in the state's rural areas, and about one-fourth of these rural residents live on farms. Iowa has one of the largest farm populations in the United States. About 300,000 Iowa residents live on farms.

Approximately 93 percent of Iowa's people are non-Hispanic whites. The state's largest population groups include people of German, Irish, English, Dutch, Norwegian, and Swedish descent. Hispanics, who may be of any race, make up 3 percent of the population. African Americans account for 2 percent, and Asians make up 1 percent.

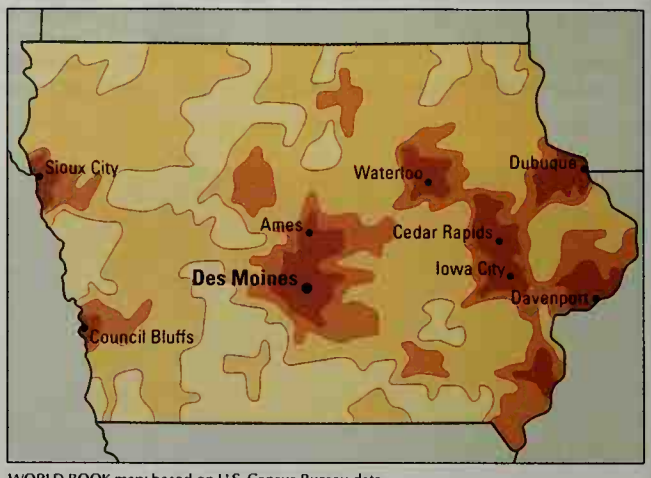
Schools. Iowa's first school opened in 1830 near what is now Galland in Lee County. The school was a small log cabin built by Isaac Galland, a physician. The teacher was paid by being allowed to read Galland's medical books.

The territorial legislature of Iowa created a system of free public schools in 1839. Iowa established a system of free high schools in 1911. The state also established one of the first public schools for children with physical disabilities in the United States. This school, the David W. Smouse Opportunity School, opened in Des Moines in 1931.

A nine-member State Board of Education directs the public school system of Iowa. The governor appoints the board members to terms of six years. The governor

Population density

About 45 percent of Iowa's people live in metropolitan areas. Iowa has one of the nation's largest farm populations. About 10 percent of the state's people live on farms.



WORLD BOOK map; based on U.S. Census Bureau data.

Craig Aurness, West Light

Yard auctions, such as this one in Garnavillo, occur frequently in Iowa's many small towns and rural areas.

Craig Aurness, West Light

A livestock show in Spencer features prize farm animals. Such shows give young people an opportunity to learn about livestock farming, one of Iowa's major economic activities.

appoints a state director of education, who serves as the board's executive officer for four years.

In 1965, the legislature authorized the establishment of community colleges and vocational schools. Fifteen of these schools are in operation.

Iowa law requires children to attend school from age 6 through 15. For the number of students and teachers in Iowa, see **Education** (table: Students, teachers, and school expenditures).

Libraries. The first public library in Iowa was established in Fairfield in 1853. Along with the public libraries that serve the cities and towns, regional library systems provide backup library services. The State Library in Des Moines has legal, medical, U.S. census, U.S. patents, and state document information. Books, newspapers, and various other materials on Iowa history are housed in State Historical Society libraries in Des Moines and Iowa City. The Herbert Hoover Library in West Branch has the public papers of the 31st president of the United States. Major academic libraries include those at the University of Iowa, Iowa State University, the University of Northern Iowa, and Drake University.

Museums. The Sanford Museum and Planetarium in Cherokee features exhibits on archaeology, astronomy, and geology. The Grout Museum of History and Science in Waterloo has exhibits on Indian lore and pioneer life, and a planetarium. American and European paintings and sculptures are displayed at the Des Moines Art Center. The Science Center of Iowa in Des Moines has science and technology exhibits.

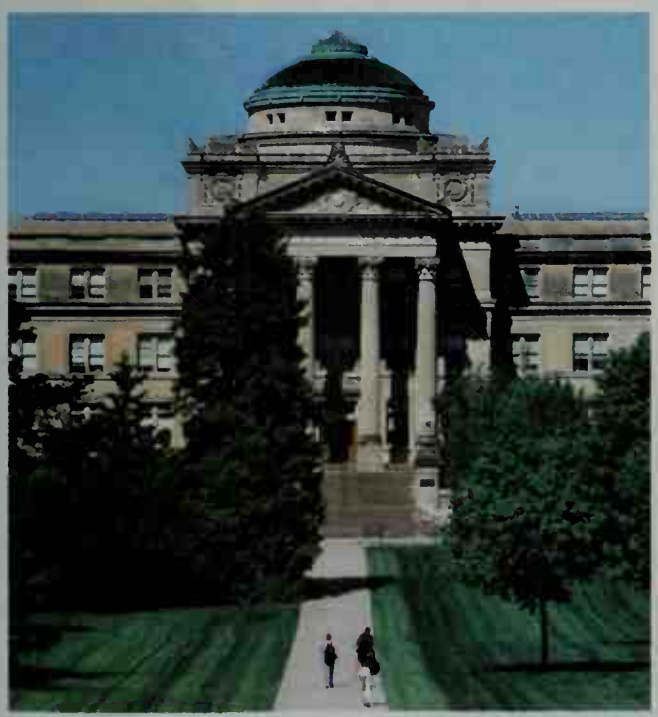
The state historical museum in Des Moines features exhibits on the history of Iowa. The University of Iowa in Iowa City has museums of natural history and art. The Putnam Museum of History and Natural Science in Davenport has displays on local and regional history. The Vesterheim Norwegian-American Museum in Decorah features exhibits on Norwegian culture in the United States.

Universities and colleges

This table lists the universities and colleges in Iowa that grant bachelor's or advanced degrees and are accredited by the North Central Association of Colleges and Schools.

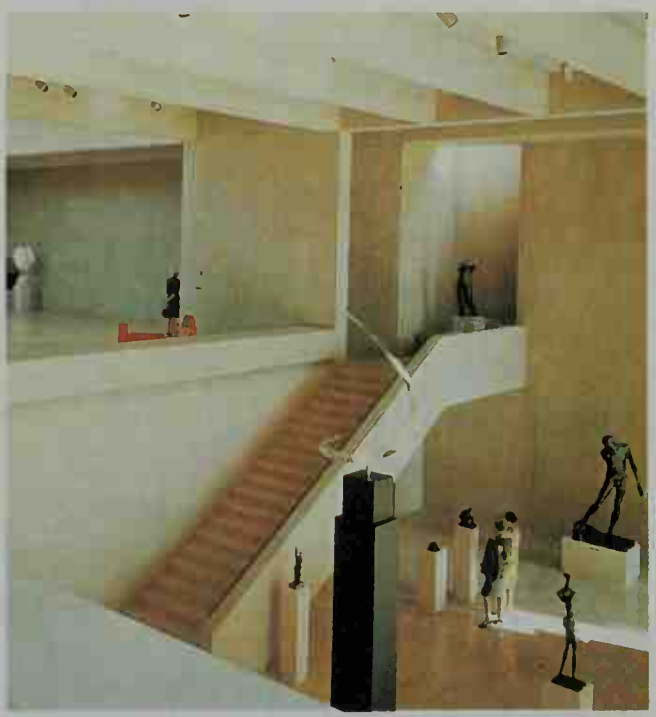
Name	Mailing address	Name	Mailing address	Name	Mailing address
Allen College	Waterloo	Graceland University	Lamoni	Morningside College	Sioux City
Briar Cliff University	Sioux City	Grand View College	Des Moines	Mount Mercy College	Cedar Rapids
Buena Vista University	Storm Lake	Grinnell College	Grinnell	Mount St. Clare College	Clinton
Central College	Pella	Hamilton College	*	Northern Iowa, University of	Cedar Falls
Clarke College	Dubuque	Iowa, University of	Iowa City	Northwestern College	Orange City
Coe College	Cedar Rapids	Iowa State University	Ames	Palmer College of Chiropractic	Davenport
Cornell College	Mount Vernon	Iowa Wesleyan College	Mount Pleasant	St. Ambrose University	Davenport
Des Moines University - Osteopathic Medical Center	Des Moines	Kaplan College	Davenport	Simpson College	Indianola
Divine Word College	Epworth	Loras College	Dubuque	Upper Iowa University	Fayette
Dordt College	Sioux Center	Luther College	Decorah	Waldorf College	Forest City
Drake University	Des Moines	Maharishi University of Management	Fairfield	Wartburg College	Waverly
Dubuque, University of	Dubuque	Marycrest International University	Davenport	Wartburg Theological Seminary	Dubuque
Faith Baptist Bible College and Seminary	Ankeny	Mercy College of Health Sciences	Des Moines	William Penn University	Oskaloosa

*Campuses at Cedar Rapids, Mason City, and Urbandale.



Iowa State University, Ames

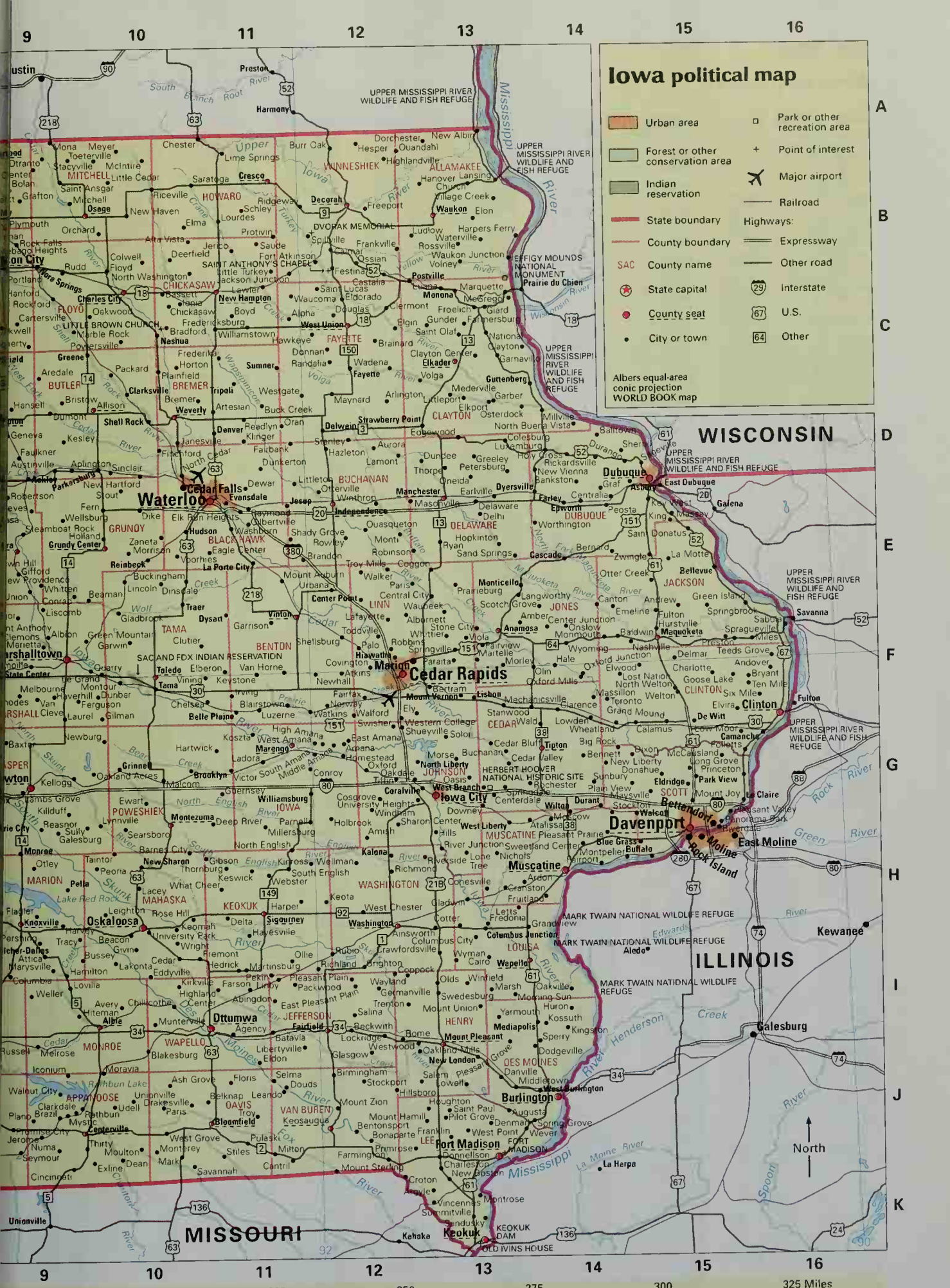
Iowa State University in Ames has administrative offices in Beardshear Hall, *shown here.* The hall was named for William M. Beardshear, president of the school from 1891 to 1902.



Des Moines Art Center

The Des Moines Art Center includes the Cowles Sculpture Court, *shown here.* The center also displays collections of American and European paintings from the 1800's and 1900's.

1 2 3 4 5 6 7 8
A B C D E F G H I J K
MINNESOTA
SOUTH DAKOTA
NEBRASKA
MISSOURI
Luverne
South Heron Lake
Wortkington
Jackson
Fairmont
Blue Earth
Albert Lea
Albert Lea Lake
Granite
Larchwood
Lester
Rock Rapids
Little Rock
Lake Park
Harris
Spirit Lake
Orleans
Huntington
Superior
Dolliver
Estherville
Ledyard
Stevens
Rake
Scarville
Lake Mills
Klondike
LYON
Edna
Sibley
Ocheyedan
Allendorf
Montgomery
Wahpeton
Okoboji
Arnolds Park
Gruver
Armstrong
Gerled
Buffalo Center
WINNEBAGO
Joice
Alvord
George
Cloverdale
OSCEOLA
West Okoboji Lake
West Okoboji
Raleigh
EMMET
Maple Hill
Swea City
Lakota
Thompson
Leland
WORTH
Canton
Inwood
Ashton
May City
Milford
Old Town
Terril
Wallingford
Halfa
Bancroft
UNION SLOUGH NATIONAL WILDLIFE REFUGE
Forest City
Hanlontown
Fertile
Beloit
Doon
Melvin
DICKINSON
Ringsted
Seneca
Rock
Matlock
Boyden
Ritter
Fostoria
Langdon
Graettinger
Fenton
Lone Rock
Titonka
Woden
Crystal Lake
Rock Valley
Perkins
Hull
Sheldon
Sanborn
Osgood
Depew
Burt
Carmel
Hartley
Everly
Spencer
Ruthven
Lotts Creek
Hayfield
Miller
Clear Lake
Lebanon
Sioux Center
Hospers
Archer
Moneta
Primghar
Dickens
Emmetsburg
KOSSUTH
Sexton
Wesley
Britt
Duncan
Ventura
Emery
Hawarden
SIOUX
O'BRIEN
Royal
CLAY
Cylinder
Algona
Hutchins
Garner
Ireton
Orange City
Alton
Gaza
Greenville
Rossie
Ayrshire
PALO ALTO
Whittemore
Saint Benedict
Stilson
Central Heights
Paullina
Granville
Maurice
Germantown
Sutherland
Gillett Grove
Rodman
Irvington
Corwith
Klemme
Burchinal
CERRO GORDO
Chatsworth
Calumet
Peterson
Curlew
Webb
GROTTO OF THE REDEMPTION
West Bend
Galbraith
Hanna
Denhart
HANCOCK
Swaledale
Thornton
Goodell
Craig
Struble
Seney
Cornell
Sioux Rapids
Mallard
Saint Joseph
Lu Verne
Kanawha
Meservey
Akron
Brunsville
Larrabee
Linn Grove
Marathon
Plover
Ottosen
Livermore
Oyens
Marcus
Cleghorn
Laurens
Bode
Renwick
Belmond
West Le Mars
Le Mars
Remsen
Meriden
Rembrandt
Havelock
Rolfe
Bradgate
Hardy
Cornelia
Westfield
Adaville
PLYMOUTH
Mary Hill
Cherokee
Albert City
Ware
Rutland
HUMBOLDT
WRIGHT
Alexander
Merrill
CHEROKEE
Aurelia
Truesdale
Pocahontas
Gilmore City
Dakota City
Holmes
Latimer
Neptune
Fielding
Alta
BUENA VISTA
POCAHONTAS
Humboldt
Goldfield
Clarion
Rowan
Coulter
Hinton
Storm Lake
Varina
Thor
Galt
FRANKLIN
Quimby
Diamond Center
Sulphur Springs
Pioneer
Eagle Grove
Dows
James
Kingsley
Washta
Lakeside
Hanover
Newell
Juniata
Palmer
Fonda
Badger
Bradford
Sioux City
Pierson
Clare
Vincent
Woolstock
Oakland
Popejoy
Burdette
South Sioux City
Lawton
Correctionville
Moville
Holstein
Galva
Schaller
Nemaha
Pomeroy
Knoke
Manson
Iowa Falls
FLOYD MONUMENT
Bronson
Cushing
Early
Barnum
Fort Dodge
Blairsburg
Alden
Williams
Sergeant Bluff
Anthon
IDA
Jolley
Knierim
Moorland
Coalville
Highview
Luton
Climbing Hill
Ida Grove
Arthur
Sac City
Lytton
Lavinia
Richards
Otho
Kalo
Duncombe
Webster City
Buckeye
Salix
WOODBURY
Battle Creek
SAC
Rockwell City
CALHOUN
Somers
Callender
Lehigh
Homer
HAMILTON
Kamrar
HARDIN
Oto
Odebolt
Lake View
Sherwood
Piper
Rinard
WEBSTER
Burnside
Boone
Ellsworth
Radcliffe
Sloan
Holly Springs
Smithland
Wall Lake
Ulmer
Yetter
Rands
Lohrville
Gowrie
Harcourt
Stanhope
Jewell
Hubbard
Hornick
Danbury
Carnarvon
Auburn
Lake City
Farnhamville
Dayton
Stratford
Randall
Garden City
Rodney
Lanyon
Whiting
Mapleton
Schleswig
Kiron
Boyer
Breda
Mount Carmel
Lanesboro
Adaza
Paton
Boxholm
Story City
McCallsburg
Ricketts
Churdan
Pilot Mound
Roland
Zearing
Castana
MONONA
Berne
CRAWFORD
Deloit
Maple River
Lidderdale
Dana
Fraser
Mackey
Gilbert
Onawa
Ute
Charter Oak
Westside
Arcadia
Vail
Glidden
Farlin
GREENE
Logansport
Fernald
42 North Latitude
Blue Lake
Turin
Carroll
Ralston
Scranton
Ogden
Jordan
Ames
Nevada
Soldier
Denison
Halbur
Roselle
Jefferson
Grand Junction
Beaver
Moingona
Luther
Napier
Blencoe
Moorhead
Arion
Dow City
Buck Grove
Aspinwall
Templeton
CARROLL
Willey
Carrollton
Cooper
Rippey
Berkley
BOONE
Kelley
STORY
Cambridge
Collins
Oakland
Manilla
Manning
Dedham
Coon Rapids
Jamaica
Angus
Huxley
Maxwell
Pisgah
Little Sioux
River Sioux
Dunlap
Botna
Gray
Bayard
Bagley
Herndon
Dawson
Woodward
Madrid
Slater
Sheldahl
Defiance
Irwin
Viola Center
Ross
Perry
Gardiner
Bouton
Moran
Alleman
Farrar
Elkhart
Logan
Woodbine
Earling
Kirkman
Audubon
Fansler
Yale
Saylorville Reservoir
Polk City
Mondamin
Panama
Westphalia
SHELBY
Wichita
Minburn
Granger
Ankeny
Green Castle
Magnolia
HARRISON
Portsmouth
Harlan
Sharon
AUDUBON
Hamlin
Guthrie Center
Panora
Panther
DALLAS
Grimes
Saylorville
Bondurant
POLK
Valeria
Modale
Persia
Tennant
Jacksonville
Kimballton
Exira
Monteith
GUTHRIE
Linden
Dallas Center
Johnston
Urbandale
Mitchellville
Norwoodville
California Junction
Blair
Missouri Valley
Corley
Elk Horn
North Branch
Glendon
Redfield
Adel
Waukee
Windsor Heights
Clive
Altoona
Capitol Heights
DE SOTO BEND NATIONAL WILDLIFE REFUGE
Beebeetown
Shelby
Brayton
Adair
Casey
Menlo
Dexter
Van Meter
West Des Moines
Boeneville
Pleasant Hill
Avon
Vandalia
Fremont
Loveland
Neola
Minden
Avoca
Walnut
Lorah
Marne
Anita
Stuart
Earlham
De Soto
Cumming
Runnells
Carlisle
Honey Creek
Atlantic
Wiota
Canby
Howe
Hartford
Swan
Underwood
Crescent
McClelland
Hancock
POTTAWATTAMIE
Arbor Hill
Pitzer
MADISON
Des Moines
Norwalk
Spring Hill
Pleasantville
Omaha
Carter Lake
Council Bluffs
Oakland
CASS
ADAIR
Greenfield
Winterset
Patterson
Churchville
Prole
Ackworth
Beech
Indianola
Lewis
Cumberland
Fontanelle
Bevington
Martensdale
Wick
Saint Marys
Saint Charles
Milo
Treynor
Carson
Griswold
Massena
Bridgewater
Hebron
Macksburg
Hartley
Truro
WARREN
Manawa
Macedonia
Lyman
Dewey
Fisk
Zion
Orient
East Peru
Barney
Liberty Center
New Virginia
Lacona
Mineola
Henderson
Silver City
Wales
Elliott
Grant
Stennett
Mount Etna
Lincoln Center
Williamson
Carl
Nevinville
Spaulding
Lorimor
Liberty
Jamison
Norwood
Oakley
Williamson
Glenwood
MILLS
Mortons Mill
Scriola
Carbon
ADAMS
Quincy
Craston
CLARKE
Plattsmouth
Pacific Junction
Hastings
Malvern
Emerson
Red Oak
Tenville
Dickieville
Corning
Prescott
Cromwell
Afton
Thayer
Murray
Talmage
Osceola
Lucas
Chariton
Strahan
Stanton
MONTGOMERY
Stringtown
Brooks
Mercer
Kent
Arispe
UNION
Hopeville
Woodburn
Leslie
White Breast
LUCAS
Derby
Tabor
Coburg
Imogene
Villisca
Nodaway
Shannon City
Weldon
Le Roy
Bartlett
Randolph
Essex
Hepburn
Lenox
TAYLOR
Tingley
Ellston
Grand River
Van Wert
Humeston
Millerton
Thurman
Anderson
FREMONT
PAGE
Sharpsburg
Diagonal
Beaconsfield
Garden Grove
DECATUR
Cambria
Percival
Sidney
Shenandoah
Norwich
Clarinda
Hawleyville
Gravity
Clearfield
Conway
RINGGOLD
Mount Ayr
Kellerton
Leon
Corydon
WAYNE
Farragut
Bingham
Yorktown
New Market
Bedford
Benton
Maloy
Delphos
Decatur City
Allerton
Woodland
Harvard
Riverton
Payne Junction
Coin
College Springs
Shambaugh
Siam
Blockton
Lamoni
Davis City
New Buda
Clio
Seymour
Nebraska City
Hamburg
Northboro
Blanchard
Braddyville
Athelstan
Redding
Pleasanton
Lineville
Tarkio
Auburn
Princeton
96 West Longitude
Big Sioux River
Rock River
Floyd River
Little Sioux River
Ocheyedan River
Des Moines River
East Fork Des Moines River
West Fork Des Moines River
Blue Earth River
Winnebago River
Iowa River
Boone River
Lizard Creek
North Raccoon River
Middle Raccoon River
South Raccoon River
Cedar Creek
Maple River
Soldier River
Boyer River
Mosquito Creek
West Nishnabotna River
Nishnabotna River
Middle River
Missouri River
Elkhorn River
Logan Creek
Platte River
Little Nemaha River
East Nodaway River
West Nodaway River
Nodaway River
Platte River
East Fork Grand River
Thompson River
Weldon River
Chariton River
White Breast Creek
Skunk River
Little Sioux River
West Fork
North River
229 90 75 59 71 4 169 69 35 9 18 3 20 29 175 30 44 680 80 92 25 34 26 2 65 14 136 235
0 10 20 30 40 50 60 70 80 90 100 120 140 160
0 10 20 30 40 50 60 70 80 90 100 120 140 160 180 200 225 250


Iowa political map
Urban area
Forest or other conservation area
Indian reservation
State boundary
County boundary
SAC County name
State capital
County seat
City or town
Park or other recreation area
Point of interest
Major airport
Railroad
Highways:
Expressway
Other road
29 Interstate
67 U.S.
64 Other
Albers equal-area conic projection
WORLD BOOK map
WISCONSIN
ILLINOIS
MISSOURI
Waterloo
Cedar Falls
Cedar Rapids
Dubuque
Davenport
Bettendorf
Moline
Rock Island
East Moline
Iowa City
Clinton
Muscatine
Burlington
Fort Madison
Keokuk
Ottumwa
Oskaloosa
Marshalltown
Mason City
Fort Dodge
Sioux City
Council Bluffs
Des Moines
Creston
Centerville
Knoxville
Pella
Grinnell
Newton
Boone
Ames
Carroll
Storm Lake
Spencer
Estherville
Algona
Webster City
Clear Lake
Mason City
Charles City
Decorah
Waukon
Postville
Prairie du Chien
Monona
Guttenberg
Elkader
Strawberry Point
Manchester
Delhi
Monticello
Anamosa
Maquoketa
Bellevue
Galena
Savanna
Fulton
Camanche
De Witt
Tipton
Wilton
Durant
Walcott
Eldridge
Princeton
Le Claire
Kewanee
Galesburg
Aledo
Monmouth
Oquawka
Carthage
Hamilton
Nauvoo
Montrose
Keokuk Dam
Old Ivins House
Effigy Mounds National Monument
Upper Mississippi River Wildlife and Fish Refuge
Mark Twain National Wildlife Refuge
Herbert Hoover National Historic Site
Sac and Fox Indian Reservation
North
Albers equal-area conic projection
WORLD BOOK map
9 10 11 12 13 14 15 16
A B C D E F G H I J K
180 200 225 250 275 300 325 Miles
300 325 350 375 400 425 450 475 500 525 Kilometers

Iowa map index

Metropolitan areas

Cedar Rapids 191,701
Davenport-Moline (Ill.)-Rock Island (Ill.) ..... 359,062 (200,394 in Ill.; 158,668 in Ia.)
Des Moines 456,022
Dubuque 89,143
Iowa City 111,006
Omaha (Nebr.) ..... 716,998 (629,294 in Nebr.; 87,704 in Ia.)
Sioux City ..... 124,130 (103,877 in Ia.; 20,253 in Nebr.)
Waterloo-Cedar Falls 128,012

Counties

Adair ..... 8,243 ..H 5
Adams ..... 4,482 ..I 5
Allamakee ..... 14,675 ..B 13
Appanoose ..... 13,721 ..J 9
Audubon ..... 6,830 ..G 4
Benton ..... 25,308 ..F 11
Black Hawk ..... 128,012 ..E 11
Boone ..... 26,224 ..F 7
Bremer ..... 23,325 ..C 10
Buchanan ..... 21,093 ..D 12
Buena Vista ..... 20,411 ..D 4
Butler ..... 15,305 ..C 9
Calhoun ..... 11,115 ..E 5
Carroll ..... 21,421 ..F 4
Cass ..... 14,684 ..H 4
Cedar ..... 18,187 ..G 13
Cerro Gordo ..... 46,447 ..C 8
Cherokee ..... 13,035 ..D 3
Chickasaw ..... 13,095 ..B 10
Clarke ..... 9,133 ..I 7
Clay ..... 17,372 ..B 4
Clayton ..... 18,678 ..D 13
Clinton ..... 50,149 ..F 15
Crawford ..... 16,942 ..F 3
Dallas ..... 40,750 ..G 6
Davis ..... 8,541 ..J 11
Decatur ..... 8,689 ..J 7
Delaware ..... 18,404 ..E 13
Des Moines ..... 42,351 ..J 13
Dickinson ..... 16,424 ..B 4
Dubuque ..... 89,143 ..E 14
Emmet ..... 11,027 ..B 5
Fayette ..... 22,008 ..C 12
Floyd ..... 16,900 ..C 9
Franklin ..... 10,704 ..D 8
Fremont ..... 8,010 ..J 3
Greene ..... 10,366 ..F 6
Grundy ..... 12,369 ..E 10
Guthrie ..... 11,353 ..G 6
Hamilton ..... 16,438 ..E 7
Hancock ..... 12,100 ..C 7
Hardin ..... 18,812 ..E 8
Harrison ..... 15,666 ..G 2
Henry ..... 20,336 ..I 13
Howard ..... 9,932 ..B 11
Humboldt ..... 10,381 ..D 6
Ida ..... 7,837 ..E 3
Iowa ..... 15,671 ..G 11
Jackson ..... 20,296 ..E 15
Jasper ..... 37,213 ..G 9
Jefferson ..... 16,181 ..J 11
Johnson ..... 111,006 ..G 12
Jones ..... 20,221 ..F 14
Keokuk ..... 11,400 ..H 11
Kossuth ..... 17,163 ..B 6
Lee ..... 38,052 ..J 13
Linn ..... 191,701 ..F 12
Louisa ..... 12,183 ..I 13
Lucas ..... 9,422 ..I 8
Lyon ..... 11,763 ..A 1
Madison ..... 14,019 ..H 6
Mahaska ..... 22,335 ..H 10
Marion ..... 32,052 ..H 9
Marshall ..... 39,311 ..F 9
Mills ..... 14,547 ..I 3
Mitchell ..... 10,874 ..B 10
Monona ..... 10,020 ..F 2
Monroe ..... 8,016 ..I 10
Montgomery ..... 11,771 ..I 4
Muscatine ..... 41,722 ..H 13
O'Brien ..... 15,102 ..C 3
Osceola ..... 7,003 ..B 3
Page ..... 16,976 ..J 4
Palo Alto ..... 10,147 ..C 5
Plymouth ..... 24,849 ..D 2
Pocahontas ..... 8,662 ..D 5
Polk ..... 374,601 ..G 8
Pottawattamie ..... 87,704 ..H 3
Poweshiek ..... 18,815 ..G 10
Ringgold ..... 5,469 ..J 6
Sac ..... 11,529 ..E 4
Scott ..... 158,668 ..G 15
Shelby ..... 13,173 ..G 4
Sioux ..... 31,589 ..C 1
Story ..... 79,981 ..F 8
Tama ..... 18,103 ..F 10
Taylor ..... 6,958 ..J 5
Union ..... 12,309 ..I 6
Van Buren ..... 7,809 ..J 11
Wapello ..... 36,051 ..J 10
Warren ..... 40,671 ..I 8
Washington ..... 20,670 ..H 12
Wayne ..... 6,730 ..J 8
Webster ..... 40,235 ..E 6
Winnebago ..... 11,723 ..A 7
Winneshiek ..... 21,310 ..B 12
Woodbury ..... 103,877 ..E 2
Worth ..... 7,909 ..B 8
Wright ..... 14,334 ..D 7

Cities and towns

Ackley ..... 1,809 ..D 9
Ackworth ..... 85 ..H 8
Adair ..... 839 ..H 5
Adel° ..... 3,435 ..G 7
Afton ..... 917 ..I 6
Agency ..... 622 ..I 11
Ainsworth ..... 524 ..H 12
Akron ..... 1,489 ..C 1
Albert City ..... 709 ..D 4
Albia° ..... 3,706 ..I 10
Albion ..... 592 ..F 9
Alburnett ..... 559 ..F 12
Alden ..... 904 ..D 8
Alexander ..... 165 ..D 8
Algona° ..... 5,741 ..C 6
Alleman ..... 439 ..G 7
Allerton ..... 559 ..J 8
Allison° ..... 1,006 ..D 10
Alta ..... 1,865 ..D 4
Alta Vista ..... 286 ..B 10
Alton ..... 1,095 ..C 2
Altoona ..... 10,345 ..G 8
Alvord ..... 187 ..B 1
Amana ..... G 12
Ames ..... 50,731 ..F 8
Anamosa° ..... 5,494 ..F 13
Andover ..... 87 ..F 16
Andrew ..... 460 ..E 15
Anita ..... 1,049 ..H 5
Ankeny ..... 27,117 ..G 8
Anthon ..... 649 ..E 2
Aplington ..... 1,054 ..D 9
Arcadia ..... 443 ..F 4
Archer ..... 126 ..B 3
Aredale ..... 89 ..C 9
Arion ..... 136 ..F 3
Arispe ..... 89 ..I 6
Arlington ..... 490 ..D 12
Armstrong ..... 979 ..B 6
Arnolds Park ..... 1,162 ..B 4
Arthur ..... 245 ..E 4
Asbury ..... 2,450 ..D 14
Ashton ..... 461 ..B 2
Aspinwall ..... 58 ..F 4
Atalissa ..... 283 ..G 14
Athelstan ..... 18 ..K 5
Atkins ..... 977 ..F 12
Atlantic° ..... 7,257 ..H 4
Auburn ..... 296 ..E 5
Audubon° ..... 2,382 ..G 4
Aurelia ..... 1,062 ..D 3
Aurora ..... 194 ..D 12
Avery ..... I 10
Avoca ..... 1,610 ..H 3
Avon ..... H 8
Ayrshire ..... 202 ..C 5
Badger ..... 610 ..D 6
Bagley ..... 354 ..G 6
Baldwin ..... 127 ..F 14
Balltown ..... 73 ..D 14
Bancroft ..... 808 ..B 6
Bankston ..... 27 ..D 14
Barnes City ..... 201 ..H 10
Barnum ..... 195 ..D 6
Bassett ..... 74 ..C 10
Batavia ..... 500 ..I 11
Battle Creek ..... 743 ..E 3
Baxter ..... 1,052 ..G 9
Bayard ..... 536 ..G 5
Beacon ..... 518 ..H 10
Beaconsfield ..... 11 ..J 7
Beaman ..... 210 ..E 10
Beaver ..... 53 ..F 6
Bedford° ..... 1,620 ..J 5
Belle Plaine ..... 2,878 ..F 11
Bellevue ..... 2,350 ..E 15
Belmond ..... 2,560 ..C 7
Bennett ..... 395 ..G 14
Benton ..... 40 ..J 6
Berkley ..... 24 ..F 6
Bernard ..... 97 ..E 14
Bertram ..... 681 ..F 13
Bettendorf ..... 31,275 ..G 15
Bevington ..... 58 ..H 7
Birmingham ..... 423 ..J 12
Blairsburg ..... 235 ..E 7
Blairstown ..... 682 ..F 11
Blakesburg ..... 374 ..J 10
Blanchard ..... 61 ..K 4
Blencoe ..... 231 ..F 2
Blockton ..... 192 ..K 5
Bloomfield° ..... 2,601 ..J 10
Blue Grass ..... 1,169 ..H 14
Bode ..... 327 ..C 6
Bonaparte ..... 458 ..J 12
Bondurant ..... 1,846 ..G 8
Boone° ..... 12,803 ..F 7
Bouton ..... 136 ..G 7
Boxholm ..... 215 ..E 6
Boyden ..... 672 ..B 2
Braddyville ..... 176 ..K 4
Bradford ..... D 8
Bradgate ..... 101 ..D 6
Brandon ..... 311 ..E 12
Brayton ..... 145 ..H 5
Breda ..... 477 ..E 4
Bridgewater ..... 178 ..I 5
Brighton ..... 687 ..I 12
Bristow ..... 202 ..D 9
Britt ..... 2,052 ..C 7
Bronson ..... 269 ..E 1
Brooklyn ..... 1,367 ..G 10
Brunsville ..... 146 ..C 1
Buck Grove ..... 49 ..F 3
Buckeye ..... 110 ..E 8
Buffalo ..... 1,321 ..H 15
Buffalo Center ..... 963 ..B 7
Burlington° ..... 26,839 ..J 14
Burt ..... 556 ..B 6
Bussey ..... 450 ..I 9
Calamus ..... 394 ..G 15
Callender ..... 424 ..E 6
Calmar ..... 1,058 ..B 12
Calumet ..... 181 ..C 3
Camanche ..... 4,215 ..G 16
Cambridge ..... 819 ..F 8
Cantril ..... 257 ..K 11
Capitol Heights ..... G 8
Carbon ..... 28 ..I 5
Carlisle ..... 3,497 ..H 8
Carpenter ..... 130 ..B 9
Carroll° ..... 10,106 ..F 5
Carson ..... 668 ..I 3
Carter Lake ..... 3,248 ..H 2
Cascade ..... 1,958 ..E 14
Casey ..... 478 ..H 5
Castalia ..... 175 ..C 12
Castana ..... 178 ..F 2
Cedar Falls ..... 36,145 ..D 10
Cedar Rapids° ..... 120,758 ..F 12
Center Junction ..... 131 ..F 14
Center Point ..... 2,007 ..E 12
Centerville° ..... 5,924 ..J 10
Central City ..... 1,157 ..E 12
Central Heights ..... C 8
Centralia ..... 101 ..D 14
Chapin ..... C 8
Chariton° ..... 4,573 ..I 8
Charles City° ..... 7,812 ..C 10
Charlotte ..... 421 ..F 15
Charter Oak ..... 530 ..F 3
Chatsworth ..... 89 ..C 1
Chelsea ..... 287 ..F 10
Cherokee° ..... 5,369 ..D 3
Chester ..... 151 ..A 10
Chillicothe ..... 90 ..I 10
Churdan ..... 418 ..F 5
Cincinnati ..... 428 ..K 9
Clare ..... 190 ..D 6
Clarence ..... 1,008 ..F 14
Clarinda° ..... 5,690 ..J 4
Clarion° ..... 2,968 ..D 7
Clarksville ..... 1,441 ..D 10
Clayton ..... 55 ..C 13
Clear Lake ..... 8,161 ..B 8
Clearfield ..... 371 ..J 5
Cleghorn ..... 250 ..C 3
Clemons ..... 148 ..F 9
Clermont ..... 716 ..C 12
Clinton° ..... 27,772 ..F 16
Clio ..... 91 ..K 8
Clive ..... 12,855 ..G 7
Clutier ..... 229 ..F 10
Coalville† ..... 591 ..E 6
Coburg ..... 31 ..J 3
Coggon ..... 745 ..E 12
Coin ..... 252 ..J 4
Colesburg ..... 412 ..D 13
Colfax ..... 2,223 ..G 9
College Springs ..... 246 ..J 4
Collins ..... 499 ..F 8
Colo ..... 868 ..F 8
Columbus City ..... 376 ..I 13
Columbus Junction ..... 1,900 ..H 13
Colwell ..... 76 ..B 10
Conesville ..... 424 ..H 13
Conrad ..... 1,055 ..E 9
Conroy ..... G 12
Conway ..... 63 ..J 5
Coon Rapids ..... 1,305 ..F 5
Coppock ..... 57 ..I 12
Coralville ..... 15,123 ..G 12
Corning° ..... 1,783 ..I 5
Correctionville ..... 851 ..D 2
Corwith ..... 350 ..C 7
Corydon° ..... 1,591 ..J 8
Cotter ..... 48 ..H 13
Coulter ..... 262 ..D 8
Council Bluffs° ..... 58,268 ..H 2
Craig ..... 102 ..C 1
Crawfordsville ..... 295 ..I 12
Crescent ..... 537 ..H 2
Cresco° ..... 3,905 ..B 11
Creston° ..... 7,597 ..I 6
Cromwell ..... 120 ..I 6
Crystal Lake ..... 285 ..B 7
Cumberland ..... 281 ..H 5
Cumming ..... 162 ..H 7
Curlew ..... 62 ..C 5
Cushing ..... 246 ..E 3
Cylinder ..... 110 ..C 5
Dakota City° ..... 911 ..D 6
Dallas, see Melcher-Dallas
Dallas Center ..... 1,595 ..G 6
Dana ..... 84 ..F 6
Danbury ..... 384 ..E 3
Danville ..... 914 ..J 13
Davenport° ..... 98,359 ..G 14
Davis City ..... 275 ..J 7
Dawson ..... 155 ..G 6
Dayton ..... 884 ..E 7
Decatur City ..... 199 ..J 7
Decorah° ..... 8,172 ..B 12
Dedham ..... 280 ..F 5
Deep River ..... 288 ..G 11
Defiance ..... 346 ..G 4
Delaware ..... 188 ..E 13
Delhi ..... 458 ..E 13
Delmar ..... 514 ..F 15
Deloit ..... 288 ..F 3
Delphos ..... 25 ..J 6
Delta ..... 410 ..H 11
Denison° ..... 7,339 ..F 4
Denmark ..... J 13
Denver ..... 1,627 ..D 11
Derby ..... 131 ..J 8
Des Moines° ..... 198,682 ..G 8
De Soto ..... 1,009 ..G 6
Dewar ..... D 11
De Witt ..... 5,049 ..G 15
Dexter ..... 689 ..H 6
Diagonal ..... 312 ..J 6
Dickens ..... 202 ..B 4
Dike ..... 944 ..E 10
Dixon ..... 276 ..G 15
Dolliver ..... 77 ..A 5
Donahue ..... 293 ..G 15
Donnan ..... C 12
Donnellson ..... 963 ..J 13
Doon ..... 533 ..B 1
Douds† ..... 165 ..J 11
Dougherty ..... 80 ..C 9
Dow City ..... 503 ..F 3
Dows ..... 675 ..D 8
Drakesville ..... 185 ..J 10
Dubuque° ..... 57,686 ..D 15
Dumont ..... 676 ..D 9
Duncombe ..... 474 ..E 7
Dundee ..... 179 ..D 13
Dunkerton ..... 749 ..D 11
Dunlap ..... 1,139 ..G 3
Durango ..... 24 ..D 14
Durant ..... 1,677 ..G 14
Dyersville ..... 4,035 ..D 14
Dysart ..... 1,303 ..F 11
Eagle Grove ..... 3,712 ..D 7
Earlham ..... 1,298 ..H 6
Earling ..... 471 ..G 3
Earlville ..... 900 ..D 13
Early ..... 605 ..E 4
East Amana ..... G 12
East Peru ..... 153 ..I 7
Eddyville ..... 1,064 ..I 10
Edgewood ..... 923 ..D 13
Elberon ..... 245 ..F 11
Eldon ..... 998 ..J 11
Eldora° ..... 3,035 ..E 9
Eldridge ..... 4,159 ..G 15
Elgin ..... 676 ..C 12
Elk Horn ..... 649 ..G 4
Elk Run Heights ..... 1,052 ..E 11
Elkader° ..... 1,465 ..C 13
Elkhart ..... 362 ..G 8
Elkport ..... 88 ..D 13
Elliott ..... 402 ..I 4
Ellston ..... 57 ..J 6
Ellsworth ..... 531 ..E 8
Elma ..... 598 ..B 10
Ely ..... 1,149 ..F 12
Emerson ..... 480 ..I 3
Emmetsburg° ..... 3,958 ..B 5
Epworth ..... 1,428 ..E 14
Essex ..... 884 ..J 4
Estherville° ..... 6,656 ..A 5
Evansdale ..... 4,526 ..E 11
Everly ..... 647 ..B 3
Exira ..... 810 ..G 5
Exline ..... 191 ..K 10
Fairbank ..... 1,041 ..D 11
Fairfax ..... 889 ..F 12
Fairfield° ..... 9,509 ..I 12
Farley ..... 1,334 ..E 14
Farmersburg ..... 300 ..C 13
Farmington ..... 756 ..J 12
Farnhamville ..... 430 ..E 6
Farragut ..... 509 ..J 3
Fayette ..... 1,300 ..C 12
Fenton ..... 317 ..B 6
Ferguson ..... 126 ..F 9
Fertile ..... 360 ..B 8
Festina ..... B 12
Floris ..... 153 ..J 11
Floyd ..... 361 ..B 10
Fonda ..... 648 ..D 5
Fontanelle ..... 692 ..H 5
Forest City° ..... 4,362 ..B 7
Fort Atkinson ..... 389 ..B 11
Fort Dodge° ..... 25,136 ..D 8
Fort Madison° ..... 10,715 ..J 13
Fostoria ..... 230 ..B 4
Franklin ..... 136 ..J 13
Fraser ..... 137 ..F 7
Fredericksburg ..... 984 ..C 11
Frederika ..... 199 ..C 11
Fredonia ..... 251 ..H 13
Fremont ..... 704 ..I 11
Fruitland ..... 703 ..H 13
Galt ..... 30 ..D 8
Galva ..... 368 ..D 3
Garber ..... 103 ..D 13
Garden Grove ..... 250 ..J 7
Garnavillo ..... 754 ..C 13
Garner° ..... 2,922 ..C 8
Garrison ..... 413 ..F 11
Garwin ..... 565 ..F 10
Geneva ..... 171 ..D 9
George ..... 1,051 ..B 2
Gibson ..... 92 ..H 11
Gilbert ..... 987 ..F 7
Gilbertville ..... 767 ..E 11
Gillett Grove ..... 55 ..C 4
Gilman ..... 600 ..F 10
Gilmore City ..... 556 ..D 5
Gladbrook ..... 1,015 ..F 10
Glenwood° ..... 5,358 ..I 2
Glidden ..... 1,253 ..F 5
Goldfield ..... 680 ..D 7
Goodell ..... 174 ..C 8
Goose Lake ..... 232 ..F 15
Gowrie ..... 1,038 ..E 6
Graettinger ..... 900 ..B 5
Graf ..... 73 ..D 14
Grafton ..... 290 ..B 9
Grand Junction ..... 964 ..F 6
Grand Mound ..... 676 ..G 15
Grand River ..... 225 ..J 7
Grandview ..... 600 ..H 14
Granger ..... 583 ..G 7
Grant ..... 102 ..I 4
Granville ..... 325 ..C 2
Gravity ..... 218 ..J 5
Gray ..... 82 ..G 4
Greeley ..... 276 ..D 13
Green Island ..... E 15
Green Mountain ..... F 10
Greene ..... 1,099 ..C 9
Greenfield° ..... 2,129 ..H 6
Greenville ..... 93 ..C 4
Grimes ..... 5,098 ..G 7
Grinnell ..... 9,105 ..G 10
Griswold ..... 1,039 ..I 4
Grundy Center° ..... 2,596 ..E 9
Gruver ..... 106 ..B 5
Guernsey ..... 70 ..G 11
Guthrie Center° ..... 1,668 ..G 5
Guttenberg ..... 1,987 ..C 13
Halbur ..... 202 ..F 4
Hamburg ..... 1,240 ..K 3
Hamilton ..... 144 ..J 9
Hampton° ..... 4,218 ..D 9
Hancock ..... 207 ..H 3
Hanford ..... C 9
Hanlontown ..... 229 ..B 8
Hansell ..... 96 ..D 9
Harcourt ..... 340 ..E 6
Hardy ..... 57 ..C 6
Harlan° ..... 5,282 ..G 4
Harper ..... 134 ..H 11
Harpers Ferry ..... 330 ..B 13
Harris ..... 200 ..A 3
Hartford ..... 759 ..H 8
Hartley ..... 1,733 ..B 3
Hartwick ..... 83 ..G 10
Harvey ..... 277 ..H 9
Hastings ..... 214 ..I 3
Havelock ..... 177 ..C 5
Haverhill ..... 170 ..F 9
Hawarden ..... 2,478 ..C 1
Hawkeye ..... 489 ..C 11
Hayesville ..... 64 ..H 11
Hazleton ..... 950 ..D 12
Hedrick ..... 837 ..I 11
Henderson ..... 171 ..I 3
Hepburn ..... 39 ..J 4
Hesper ..... A 12
Hiawatha ..... 6,480 ..F 12
Hills ..... 679 ..H 13
Hillsboro ..... 205 ..J 12
Hinton ..... 808 ..D 1
Hiteman ..... I 9
Holland ..... 250 ..E 9
Holstein ..... 1,470 ..D 3
Holy Cross ..... 339 ..D 14
Homestead ..... G 12
Hopkinton ..... 681 ..E 13
Hornick ..... 253 ..E 2
Hospers ..... 672 ..C 2
Houghton ..... 130 ..J 13
Hubbard ..... 885 ..E 8
Hudson ..... 2,117 ..E 10
Hull ..... 1,960 ..B 2
Humboldt ..... 4,452 ..D 6
Humeston ..... 543 ..J 8
Huxley ..... 2,316 ..F 8
Ida Grove° ..... 2,350 ..E 3
Imogene ..... 66 ..J 3
Independence° ..... 6,014 ..E 12
Indianola° ..... 12,998 ..H 8
Inwood ..... 875 ..B 1
Ionia ..... 277 ..C 10
Iowa City° ..... 62,220 ..G 13
Iowa Falls ..... 5,193 ..D 8
Ireton ..... 585 ..C 1
Irwin ..... 372 ..G 4
Jackson Junction ..... 60 ..B 11
Jamaica ..... 237 ..G 6
Janesville ..... 829 ..D 10
Jefferson° ..... 4,626 ..F 6
Jesup ..... 2,212 ..E 11
Jewell ..... 1,239 ..E 7
Johnston ..... 8,649 ..G 7
Joice ..... 231 ..B 8
Jolley ..... 54 ..D 5
Kalo ..... E 6
Kalona ..... 2,293 ..H 12
Kamrar ..... 229 ..E 7
Kanawha ..... 739 ..C 7
Kellerton ..... 372 ..J 6
Kelley ..... 300 ..F 7
Kellogg ..... 606 ..G 9
Kensett ..... 280 ..B 9

Kent ..... 52 .. I 6
Keokuk° ..... 11,427 .. K 13
Keomah ..... 97 .. H 10
Keosauqua° ..... 1,066 .. J 11
Keota ..... 1,025 .. H 12
Keswick ..... 295 .. H 11
Keystone ..... 687 .. F 11
Killduff ..... G 9
Kimballton ..... 342 .. G 4
Kingsley ..... 1,245 .. D 2
Kinross ..... 80 .. H 12
Kirkman ..... 76 .. G 4
Kirkville ..... 214 .. J 10
Kiron ..... 273 .. E 3
Klemme ..... 593 .. C 8
Knierim ..... 70 .. E 5
Knoxville° ..... 7,731 .. H 9
Lacona ..... 360 .. I 8
Ladora ..... 287 .. G 11
Lake City ..... 1,787 .. E 5
Lake Mills ..... 2,140 .. A 8
Lake Park ..... 1,023 .. A 3
Lake View ..... 1,278 .. E 4
Lakeside ..... 484 .. D 4
Lakota ..... 255 .. B 7
Lambs Grove ..... 225 .. G 9
Lamoni ..... 2,444 .. K 7
Lamont ..... 503 .. D 12
La Motte ..... 272 .. E 15
Lanesboro ..... 152 .. E 5
Lansing ..... 1,012 .. B 13
La Porte City ..... 2,275 .. E 11
Larchwood ..... 788 .. A 1
Larrabee ..... 149 .. C 3
Latimer ..... 535 .. D 8
Laurel ..... 266 .. F 9
Laurens ..... 1,476 .. C 5
Lawler ..... 461 .. C 11
Lawton ..... 697 .. D 1
Le Claire ..... 2,847 .. G 16
Ledyard ..... 147 .. A 6
Le Grand ..... 883 .. F 9
Lehigh ..... 497 .. E 7
Leighton ..... 153 .. H 10
Leland ..... 258 .. B 8
Le Mars° ..... 9,237 .. C 2
Lenox ..... 1,401 .. J 5
Leon° ..... 1,983 .. J 7
Le Roy ..... 13 .. J 8
Lester ..... 251 .. A 1
Letts ..... 392 .. H 13
Lewis ..... 438 .. H 4
Libertyville ..... 325 .. I 11
Lidderdale ..... 186 .. F 5
Lime Springs ..... 496 .. A 11
Lincoln ..... 182 .. E 10
Linden ..... 226 .. G 6
Lineville ..... 273 .. K 8
Linn Grove ..... 211 .. C 4
Lisbon ..... 1,898 .. F 13
Liscomb ..... 272 .. F 9
Little Rock ..... 489 .. A 2
Little Sioux ..... 217 .. G 2
Littleport ..... 26 .. D 13
Livermore ..... 431 .. C 6
Lockridge ..... 275 .. I 12
Logan° ..... 1,545 .. G 2
Lohrville ..... 431 .. E 5
Lone Rock ..... 157 .. B 6
Lone Tree ..... 1,151 .. H 13
Long Grove ..... 597 .. G 15
Loveland ..... H 2
Lorimor ..... 427 .. I 7
Lost Nation ..... 497 .. F 14
Lovilia ..... 583 .. I 9
Low Moor ..... 240 .. G 15
Lowden ..... 794 .. G 14
Luana ..... 249 .. C 13
Lucas ..... 243 .. I 8
Luther ..... 158 .. F 7
Lu Verne ..... 299 .. C 6
Luxemburg ..... 246 .. D 13
Luzerne ..... 105 .. F 11
Lynnville ..... 366 .. G 10
Lytton ..... 305 .. E 5
Macedonia ..... 325 .. I 3
Macksburg ..... 142 .. I 6
Madrid ..... 2,264 .. F 7
Magnolia ..... 200 .. G 2
Malcom ..... 352 .. G 10
Mallard ..... 298 .. C 5
Maloy ..... 28 .. J 6
Malvern ..... 1,256 .. I 3
Manawa ..... I 2
Manchester° ..... 5,257 .. D 13
Manilla ..... 839 .. F 4
Manly ..... 1,342 .. B 9
Manning ..... 1,490 .. F 4
Manson ..... 1,893 .. D 5
Mapleton ..... 1,416 .. F 2
Maquoketa° ..... 6,112 .. F 15
Marathon ..... 302 .. C 4
Marble Rock ..... 326 .. C 10
Marcus ..... 1,139 .. C 2
Marengo° ..... 2,535 .. G 11
Marion ..... 26,294 .. F 12
Marne ..... 149 .. H 4
Marquette ..... 421 .. C 13
Marshalltown° ..... 26,009 .. F 9
Martelle ..... 280 .. F 13
Martensdale ..... 467 .. H 7
Martinsburg ..... 126 .. I 11
Marysville ..... 54 .. I 9
Mason City° ..... 29,172 .. B 9
Masonville ..... 104 .. E 13
Massena ..... 414 .. I 5
Matlock ..... 83 .. B 2
Maurice ..... 254 .. C 1
Maxwell ..... 807 .. F 8
May City ..... B 3
Maynard ..... 500 .. D 12
Maysville ..... 163 .. G 14
McCallsburg ..... 318 .. F 8
McCausland ..... 299 .. G 15
McClelland ..... 129 .. H 3
McGregor ..... 871 .. C 13
McIntire ..... 173 .. A 10
Mechanicsville ..... 1,173 .. F 13
Mediapolis ..... 1,644 .. I 13
Melbourne ..... 794 .. F 9
Melcher-Dallas ..... 1,298 .. I 9
Melrose ..... 130 .. I 9
Melvin ..... 243 .. B 3
Menlo ..... 365 .. H 6
Meriden ..... 184 .. C 3
Merrill ..... 754 .. D 1
Meservey ..... 252 .. C 8
Middle Amana ..... G 12
Middletown ..... 535 .. J 13
Miles ..... 462 .. F 16
Milford ..... 2,474 .. B 4
Millersburg ..... 184 .. H 11
Millerton ..... 48 .. J 8
Millville ..... 23 .. D 14
Milo ..... 839 .. H 8
Milton ..... 550 .. J 11
Minburn ..... 391 .. G 6
Minden ..... 564 .. H 3
Mineola ..... I 2
Mingo ..... 269 .. G 8
Missouri Valley ..... 2,992 .. C 2
Mitchell ..... 155 .. B 9
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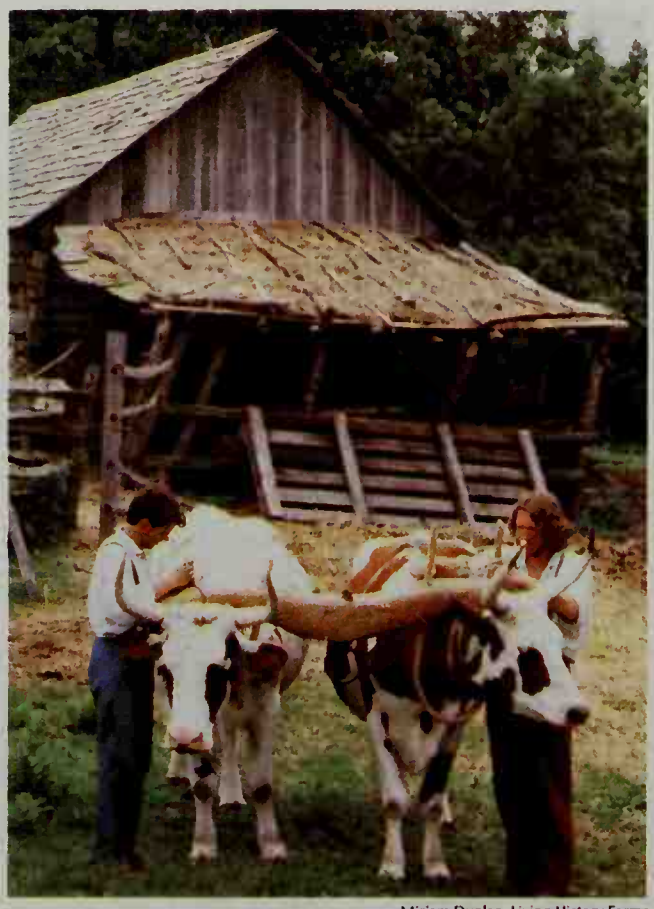
†Census designated place—unincorporated, but recognized as a significant settled community by the U.S. Census Bureau.
°County seat.

Places without population figures are unincorporated areas.
Source: 2000 census.

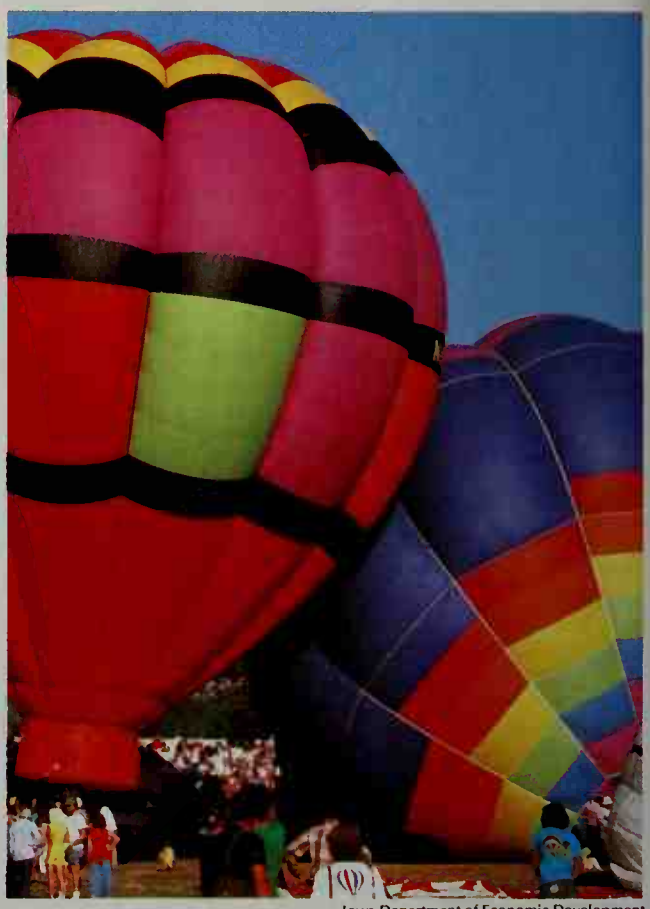
Iowa's many lakes and streams offer vacationers fine boating, fishing, and swimming. In fall, hunters seek a variety of small game. Many people enjoy hiking in the rugged northeastern part of Iowa, especially in autumn, when the wooded hills are a mass of brilliant color.

The Iowa State Fair is one of the most important annual events in Iowa. This popular fair, which offers many agricultural and industrial exhibits as well as games and rides, is held in Des Moines in August. Ethnic festivals, sports competitions, historical reenactments, and other colorful celebrations are also popular in Iowa, especially during the summer.



Miriam Dunlap, Living History Farms

Living History Farms near Des Moines



Iowa Department of Economic Development

National Hot Air Balloon Classic in Indianola

Places to visit

Following are brief descriptions of some of Iowa's most interesting places to visit.

Amana Colonies, seven German villages located southwest of Cedar Rapids, have interesting museums and popular restaurants. Visitors can watch craftworkers build furniture, make yarn, and weave fabrics.

Boone and Scenic Valley Railroad, in Boone, is an excursion train. Visitors can ride an open or enclosed passenger car through the scenic Des Moines River Valley. The train travels across one of the highest bridges in the United States.

Effigy Mounds National Monument, near Marquette, has earthen mounds built by prehistoric Indians. Some of the mounds are 300 feet (91 meters) long and are shaped like animals. For more information, see Effigy Mounds National Monument.

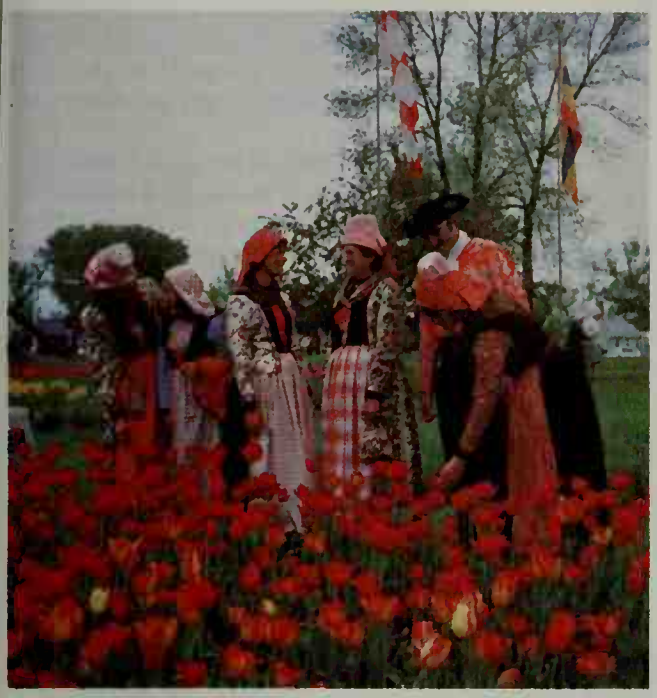
Herbert Hoover's birthplace, in West Branch, honors the 31st president of the United States. A beautiful park surrounds his birthplace cottage, a restored blacksmith shop, the presidential museum, and the library of Hoover's public papers. Hoover was buried there in 1964.

Living History Farms, in Des Moines, is a huge open-air museum that depicts agricultural life in Iowa from pioneer days to the present. Costumed interpreters at period farms demonstrate old-time crafts and skills. Traditional celebrations are held throughout the year.

Rivers and riverboats. At De Soto National Wildlife Refuge, near Missouri Valley; and in the Upper Mississippi National Wildlife and Fish Refuge, in several locations along the Mississippi River, travelers may view bald eagles or annual waterfowl migrations. Paddlewheel riverboats on the Mississippi and Missouri rivers offer sightseeing, dining, family entertainment, and casino-style gambling.

State Capitol Building and Iowa Historical Building. The gold-domed State Capitol in Des Moines was dedicated in 1884. It features historical murals, legislative chambers, and an ornate law library. The nearby Iowa Historical Building is a contemporary structure that houses permanent and changing exhibits on Iowa's history and heritage.

State parks. Iowa has over 80 state parks and state recreation areas. For more information, write to Department of Natural Resources, Wallace State Office Building, Des Moines, IA 50319.



Orange City Chamber of Commerce

Tulip Festival in Orange City

Annual events

January-March

Okoboji Winter Games (late January); St. Patrick's Day Celebration in Emmetsburg (second or third weekend in March).

April-June

Drake University Relays in Des Moines (April); Tulip Festival in Orange City and Tulip Time in Pella (May); Grant Wood Art Festival in Stone City (second Sunday in June); Dubuquefest in Dubuque (mid-May).

July-September

Riverboat Days in Clinton (early July); River-Cade in Sioux City (mid-July); Bix Beiderbecke Memorial Jazz Festival in Davenport (late July); Nordic Fest in Decorah (late July); Register's Annual Great Bicycle Ride Across Iowa (RAGBRAI) (route varies, late July); Meskwaki Indian Powwow in Tama (August); Iowa Championship Rodeo in Sidney (early August); National Hot Air Balloon Classic in Indianola (early August); National Hobo Convention in Britt (early August); National Sprint Car Race Championship in Knoxville (mid-August); Tri-State Rodeo in Fort Madison (early September); Fort Atkinson Rendezvous (late September).

October-December

Covered Bridge Festival in Madison County (second weekend in October); Forest Craft Festival in Van Buren County (mid-October); Victorian Christmas Stroll in Albia (December).

Amana Colonies

Furniture craftsman in the Amana Colonies

Midway of the Iowa State Fair in Des Moines

Des Moines Register

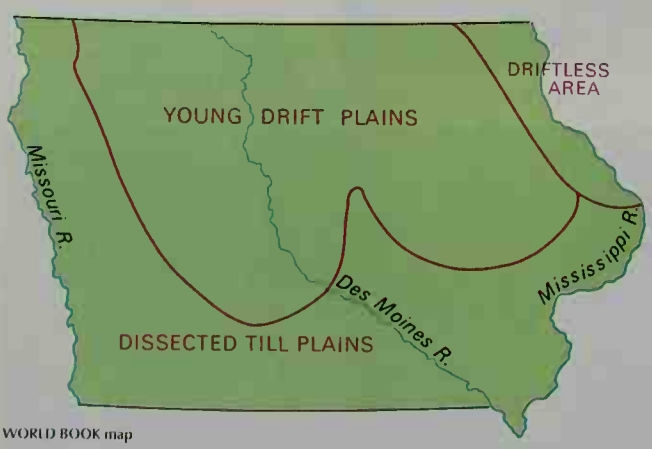
Land regions. During the Ice Age, about a million years ago, glaciers moved over the land that is now Iowa. This action was part of the vast glacial movement that helped form the fertile Midwestern Corn Belt. The great ice sheets cut off hilltops and filled valleys with rich soil, creating the plains that make up most of Iowa. The glaciers crossed different parts of the area. As a result, three separate land regions were formed. These regions are (1) the Dissected Till Plains, (2) the Young Drift Plains, and (3) the Driftless Area.

The Dissected Till Plains extend across the entire southern section of the state. They also reach along the Missouri and Big Sioux rivers into the northwestern corner. This region was covered by the first glaciers that reached Iowa. These glaciers left vast quantities of *till* (layers of soil and rocks) on the plains. For thousands of years, streams *dissected* (cut into) the plains and formed many low, rolling hills and ridges. Winds spread much of the fertile soil over the hills and ridges. Wind-blown soil also piled up along the edge of the Missouri River. This soil formed bluffs that tower from 100 to 300 feet (30 to 91 meters) above the river.

The Young Drift Plains cover most of northern and central Iowa. The glaciers that moved across this region smoothed the surface of the land until it became almost level. The melting glacial ice left deep *drift* (soil and rocks either in layers or unsorted). This drift became some of the most fertile topsoil in the world. The drift also formed many small hollows in the land, because it was not deposited evenly. The hollows filled with water and became lakes and swamps. The larger lakes are in northern and northwestern Iowa. Most of the swamps in the state have been drained and turned into good farmlands.

The Driftless Area lies parallel to the Mississippi River in northeastern Iowa. Only one glacier moved across this region. As a result, the area was not flattened as much as the other regions were. Rugged, pine-covered hills and cliffs rise throughout this section of the state, which is a popular recreation area. Iowans call it the *Switzerland of America* and enjoy hiking through the region. Most of the drift deposits have been blown or washed away, and the soil is thin and poor for farming.

Land regions of Iowa



WORLD BOOK map

Rivers and lakes. The waters of the mighty Mississippi-Missouri river system form Iowa's eastern and western borders. All rivers and streams in the state flow into this system. The Mississippi-Missouri Divide, which separates the areas drained by the two rivers, extends southeastward through western Iowa. This low ridge curves from Dickinson County in the north to Davis County in the south. Iowa's rivers and streams east of the divide flow into the Mississippi River. Those rivers and streams to the west of the divide flow into the Missouri or Big Sioux rivers.

The rivers east of the divide are long and winding. They rise in the prairies near the center of the state, and flow through shallow valleys bordered by wooded hills and bluffs. Near the Mississippi, most of the valleys are deeper and limestone cliffs appear. The Des Moines River, which flows through Iowa for 485 miles (781 kilometers), is the longest one. It drains nearly a fourth of the state. Other large eastern rivers include the Cedar, Iowa, Maquoketa, and Wapsipinicon. Clear, swift rivers wind through rocky ravines in the hilly northeast. The rivers of western Iowa are much shorter. Engineers have straightened a large number of these rivers to improve drainage.

Small, beautiful lakes dot the countryside of northern and northwestern Iowa. Some of the larger ones in the northwest are popular resort areas. These lakes include Clear, East Okoboji, West Okoboji, Spirit, and Storm lakes.

Plant and animal life. Hardwood trees grow in the valleys of Iowa's larger rivers. Common hardwoods include elms, hickories, maples, oaks, and walnuts. Cottonwood and willow trees thrive on the edges of rivers and lakes. Such conifers as balsam firs and white pines grow in northeastern Iowa.

Blue pasqueflowers border many Iowa roadsides in early spring. Other spring flowers include bloodroots, marsh marigolds, and violets. In summer, the countryside blooms with prairie lilies, purple phlox, and wild roses. Gentians, goldenrods, prairie asters, and sunflowers bloom in autumn.

The open farmlands of Iowa provide excellent nesting grounds for many kinds of birds. Partridges, quails, and ring-necked pheasants feed in the grain fields. A state hatchery in Boone County raises quails and pheasants to release as game birds. The Mississippi and Missouri flyways, both major waterfowl migration routes in spring and autumn, pass over Iowa. Thousands of birds, including ducks and Canada geese, feed in the state during their north-south flights.

Iowa has few large-game animals. Only white-tailed deer are plentiful. Cottontail rabbits, coyotes, foxes, and opossums live in most sections of the state. Jack rabbits

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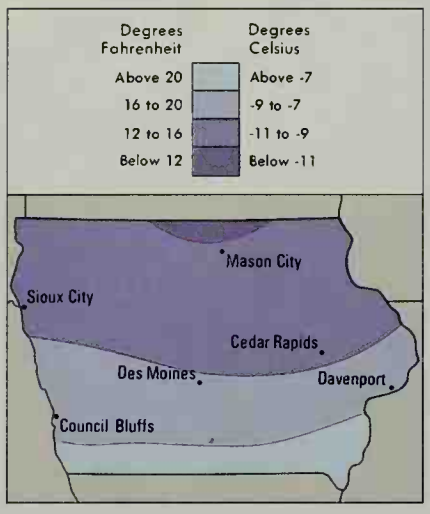
Specially created for *The World Book Encyclopedia* by Rand McNally and World Book editors

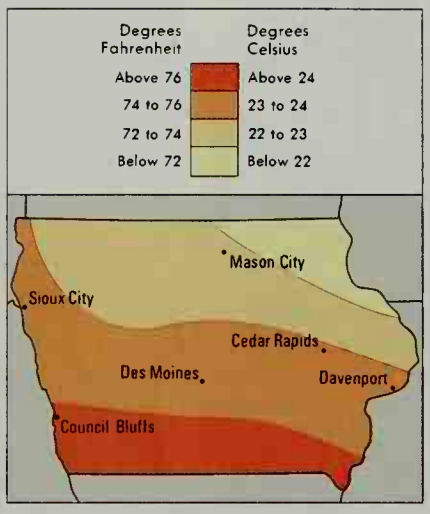
Average January temperatures

Iowa has cold winters, with temperatures dropping from the milder southern section to the colder north central area.



Average July temperatures

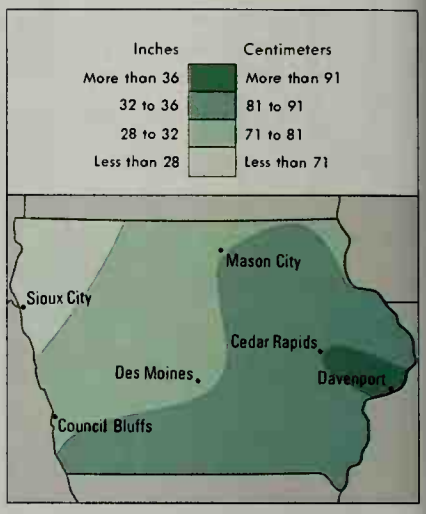
The state's summer temperatures increase steadily from the northeastern section to the far south part of Iowa.



Average yearly precipitation

The state's precipitation ranges from the relatively wet east and south to the drier northwestern section.

WORLD BOOK maps



are found mainly on the open plains in the northwestern part of Iowa.

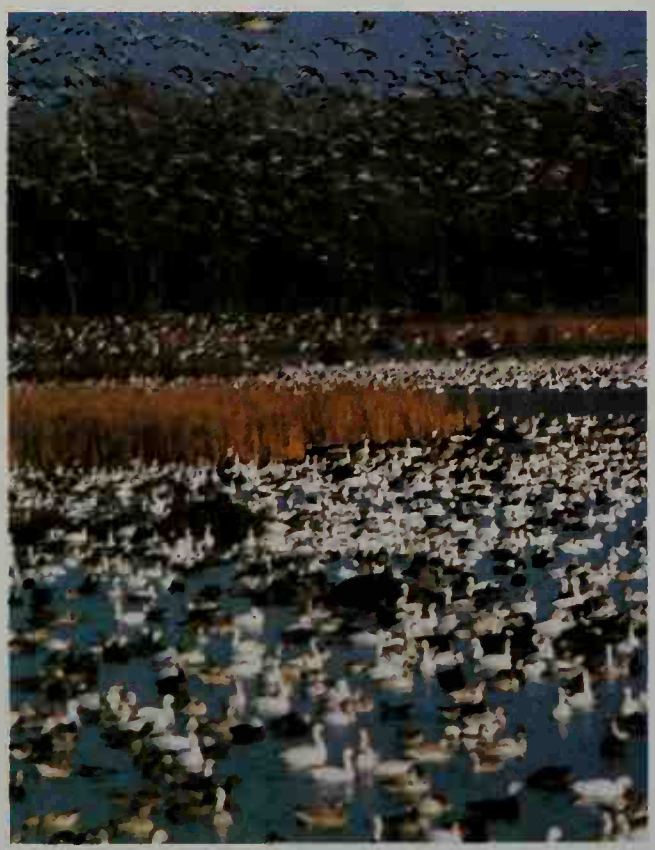
Smallmouth bass and stocked trout swim in northeastern Iowa's swift streams. Slower streams and lakes contain largemouth bass, bluegill, catfish, crappies, northern pike, and walleye.

Climate. The weather of Iowa varies greatly, with cold winters and hot summers. The temperature may drop to −20 °F (−29 °C) in winter, and rise over 100 °F (38 °C) in summer. Sometimes the temperature falls or rises 50 Fahrenheit degrees (28 Celsius degrees) within 24 hours. Cold air from the northwest or hot air from the south causes these rapid changes.

Temperatures of northern Iowa average 18 °F (−8 °C) in January and 74 °F (23 °C) in July. The southern section has an average temperature of 24 °F (−4 °C) in January and an average temperature of 77 °F (25 °C) in July. Iowa's lowest recorded temperature, −47 °F (−44 °C), occurred at Elkader on Feb. 3, 1996. The state's highest recorded temperature, 118 °F (48 °C), occurred at Keokuk on July 20, 1934.

Iowa seldom has long wet or dry periods. Winds from the Gulf of Mexico bring most of the rain. About 70 percent of it falls from April through September. The annual rainfall ranges from 26 inches (66 centimeters) in northern Iowa to 36 inches (91 centimeters) in the southeast.

Heavy snow often covers the state from January through March. The yearly snowfall averages 50 inches (130 centimeters) in northern Iowa and 22 inches (56 centimeters) in the south.



Cathy Meddin

The Mississippi flyway, a major route for migratory birds, passes over Iowa. Thousands of birds, including ducks and Canada geese, feed in the state during their north-south flights.

Average monthly weather

Des Moines	Temperatures F		Temperatures C°		Days of rain or snow
	High	Low	High	Low	
Jan.	31	13	−1	11	7
Feb.	35	17	2	−8	7
Mar.	46	28	8	−2	10
Apr.	61	40	16	4	10
May	72	51	22	11	11
June	80	61	27	16	12
July	87	66	31	19	9
Aug.	84	64	29	18	9
Sept.	76	55	24	13	8
Oct.	65	44	18	7	7
Nov.	47	29	8	−2	6
Dec.	34	18	1	−8	7

Sioux City	Temperatures F		Temperatures C°		Days of rain or snow
	High	Low	High	Low	
Jan.	29	9	−2	−13	6
Feb.	33	13	1	−11	6
Mar.	45	25	7	−4	9
Apr.	61	37	16	3	9
May	72	49	22	9	12
June	82	59	28	15	12
July	88	64	31	18	9
Aug.	85	62	29	17	9
Sept.	77	52	25	11	7
Oct.	65	40	18	4	7
Nov.	46	25	8	−4	5
Dec.	33	14	1	−10	7

Iowa has been a leading agricultural state for many years. Today, agriculture still plays a significant role in the state's economy. For example, food processing is the state's leading manufacturing activity. But Iowa is more than a farm state. Service industries employ more than two-thirds of the state's workers. Major life and health insurance companies that operate in Des Moines help make the financial sector a major part of Iowa's economy. Health care and retail trade are also important, especially in Iowa's largest cities.

Natural resources help make Iowa a leading farm state. These resources include extremely fertile soil and an abundant supply of water.

Soil. Deep layers of black, fertile topsoil cover most of the flat northern and central sections of Iowa. The rolling southern and far western sections of the state have topsoil that is thinner and less rich. But even this soil is fertile enough to produce above average crops.

Minerals. Limestone and shale deposits are found in almost all parts of Iowa, as are sand and gravel. Central Iowa has clay deposits. Beds of *bituminous* (soft) coal lie in central and southern Iowa. Des Moines and Webster counties have deposits of gypsum.

Service industries account for the largest portion of Iowa's *gross state product*—the total value of all goods and services produced in a state in a year. Iowa's leading service industries are (1) community, business, and personal services and (2) wholesale and retail trade. Both industry groups contribute about the same amount to the gross state product.

Community, business, and personal services employ more than a quarter of Iowa's workers. Such services include private health care, law firms, motels, and repair shops. Leading areas for the state's health care industry include Black Hawk, Polk, Scott, Sioux, and Story counties, each of which has four or more general hospitals.

Wholesale and retail trade is also a leading employer in Iowa. The main wholesale trade activities in the state are distributing automobiles and farm machinery to retail sellers, and distributing farm products to food processors. Leading retail establishments include automobile dealerships, grocery stores, and restaurants.

Deere & Company

Tractors are manufactured at this Waterloo factory. The production of tractors and other farm machinery is one of Iowa's chief manufacturing activities.

Production and workers by economic activities

Economic activities	Percent of GSP* produced	Employed workers	
		Number of people	Percent of total
Manufacturing	24	268,600	14
Community, business, & personal services	16	510,100	27
Wholesale & retail trade	16	421,800	22
Finance, insurance, & real estate	15	128,500	7
Government	12	245,500	13
Transportation, communication, & utilities	8	84,200	5
Agriculture	5	138,600	7
Construction	4	98,900	5
Mining	†	2,900	†
Total	100	1,900,100	100

*GSP = gross state product, the total value of goods and services produced in a year.
†Less than one-half of one percent.
Figures are for 1998.
Sources: *World Book* estimates based on data from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

Finance, insurance, and real estate form Iowa's third most important service industry in terms of the gross state product. The Des Moines area ranks among the nation's leading centers of the insurance industry. Principal Mutual Life Insurance Company, one of the largest insurance companies in the United States, is based in Des Moines. Iowa's major banking centers include Davenport, Des Moines, and Sioux City.

Government services rank next among Iowa's service industries. Iowa has a tradition of limited state government, and the federal government has few establishments in the state. Much of the government activity in Iowa revolves around public schools and hospitals, and local government administration.

The fifth ranking service industry consists of transportation, communication, and utilities. The state's transportation industry concentrates on serving factories and farmers. Trains and trucks ship manufacturing parts and finished goods to and from factories. Corn, hogs, and other farm products are shipped to food processors. Mississippi River barges are also an important means for shipping grain. More information about transportation and communication appears later in this section.

Manufacturing. Goods produced in Iowa have a *value added by manufacture* of about $28 billion a year. Value added by manufacture is the increase in value of raw materials after they become finished products.

Food processing is Iowa's leading manufacturing activity in terms of value added by manufacture. Several cities have large meat-packing plants. The production of such pork products as canned ham and breakfast sausage is important. Corn oil, cornstarch, corn sugar, and glucose are produced at plants in Cedar Rapids, Clinton, Keokuk, and Muscatine. Cedar Rapids also has one of the largest cereal mills in the United States. Sioux City has the nation's largest popcorn-processing plant. Plants that process dairy products are found throughout Iowa.

The production of machinery is Iowa's second-ranking manufacturing activity. The industry's leading products are industrial machinery and construction equip-

Economy of Iowa

This map shows the economic uses of land in Iowa and where the state's leading farm and mineral products are produced. The major urban areas (shown on the map in red) are the state's important manufacturing centers.

Mostly cropland

Grazing land mixed with cropland and woodland

Mostly forest land

Manufacturing center

Mineral deposit

WORLD BOOK map

ment. Centers of machinery production in the state include Davenport, Des Moines, Dubuque, and Waterloo.

The production of chemicals is Iowa's third most important manufacturing activity. Leading types of chemicals made in the state include agricultural chemicals, cleaning products, and pharmaceuticals.

Other goods manufactured in Iowa include electrical equipment, transportation equipment, fabricated metal products, and plastics and rubber products. Household appliances are the leading type of electrical equipment made in the state. Maytag, a leading appliance manufacturer, is based in Newton. Motor vehicle parts are the leading transportation product. Iowa's fabricated metal products include boilers and architectural materials. Factories located in the Des Moines area manufacture tires.

Agriculture. Iowa has about 100,000 farms. Farmland covers around 90 percent of the state. Only Nebraska has a greater percentage of land in farms.

Corn is Iowa's leading source of farm income. Iowa leads the states in corn production, producing about a fifth of the corn grown in the United States. Corn grows on about a fifth of the state's land. Much of the corn crop is used as feed for livestock. For winter feed, farmers harvest part of the crop while it is still green and store it in silos. Some of the corn is sold to factories that make livestock feeds and corn products.

Soybeans are also a valuable crop in Iowa. They are used for livestock feed and to make oil. Farmers often rotate soybean crops with corn crops to maintain a balance of nutrients in the soil. Iowa ranks among the leading states in soybean production.

Other major field crops include oats and hay. Alfalfa and red clover serve as cattle feed and also help restore nitrogen to the soil. Iowa farmers also grow flaxseed, rye, and wheat.

Apples are the chief fruit crop of Iowa. Vegetables cultivated in the state include cabbages, cucumbers, green beans, onions, potatoes, sweet corn, and tomatoes.

Hogs are Iowa's leading source of livestock income. More hogs are raised in Iowa than in any other state. Farms in Iowa raise about a fourth of all hogs in the United States.

Beef cattle provide the second largest source of livestock income. Iowa also ranks as a leader in the number of beef cattle. The herds graze in the grasslands of the east-central, southern, and western sections of the state. At the age of 12 to 18 months, cattle move to feedlots, where they are fed on corn and fattened for market. Many Iowa farmers buy cattle from Western states and fatten them for market.

Iowa has many dairy cattle, and it ranks among the leading states in milk production. Most of the dairy herds graze in the hilly northeastern section of the state. Farms throughout the state produce turkeys, chickens, and eggs. Iowa ranks among the leading states in both turkey and egg production. Farmers in the state also raise sheep and some horses.

Mining. Limestone, which is quarried in about two-thirds of Iowa's counties, is the main source of the state's mining income. The limestone is ground up for use in roadbeds and cement. Iowa's other mined products include clays, gypsum, and sand and gravel.

Electric power. Plants that burn coal generate approximately 85 percent of Iowa's electric power. Nuclear plants produce about 10 percent of the state's power. Most of the remaining power comes from hydroelectric plants.

Transportation. Pioneers in Iowa followed buffalo and Indian trails on horseback, in covered wagons, and on foot. Steamboat development led to busy trade on the Mississippi River between 1830 and 1870. Rail, highway, and air traffic replaced most river traffic.

Des Moines has Iowa's busiest airport. The Cedar Rapids airport is the next busiest. More than 100 small airports are scattered throughout the state.

Iowa's first railroad began operating in 1855 between Davenport and Muscatine. Today, 20 railroads provide freight service in Iowa. One railroad provides passenger service.

The Iowa State Highway Commission (now the Iowa Department of Transportation) began a major roadbuilding program in 1917 with federal aid. The commission planned for each farm with 1 square mile (2.6 square kilometers) of land to have a road on each side of the property. The state now has about 113,000 miles (182,000 kilometers) of roads and highways.

Steamboating had almost disappeared from the Mississippi River by 1890. Barge service began on the upper Mississippi during the 1920's. But the barges were sometimes stalled for long periods in summer, when water in the river dropped to a low level. By 1939, many dams and locks were built between Minneapolis, Minnesota, and Alton, Illinois. This stretch now has a 9-foot (2.7-meter) channel. The state's major Mississippi River ports include Burlington, Clinton, Davenport, Dubuque, Fort Madison, Keokuk, McGregor, and Muscatine.

The Missouri River is also able to handle barge traffic. The Mississippi River handles much more Iowa cargo than the Missouri River. Major Iowa ports on the Missouri River are Council Bluffs and Sioux City.

Communication. Iowa has about 370 newspapers, of which about 35 are dailies. The first newspaper, the *Du Buque Visitor,* began in 1836. The largest daily is the *Des Moines Register.* Other large dailies include the *Cedar Rapids Gazette,* the *Quad-City Times* of Davenport, the *Sioux City Journal,* the *Telegraph-Herald* of Dubuque, and the *Waterloo Courier.* About 130 periodicals are published in Iowa.

Iowa's first radio station, WSUI, began operating at the University of Iowa in 1919. Station WOC in Davenport became the earliest commercial station in the state in 1922. Iowa's first television station, WOC-TV, started in Davenport in 1949. The first commercial television station in the nation owned by an educational institution was WOI-TV. The station began broadcasting in 1950 from Iowa State University of Science and Technology in Ames. Today, the state has about 200 radio stations, 20 television stations, and 40 cable TV systems. Internet providers serve communities statewide.

Government

Constitution of Iowa was adopted in 1857. It replaced a constitution adopted in 1846, when the state entered the Union. Amendments to the Constitution may be proposed in either house of the state legislature, or by a constitutional convention called by the voters. An amendment proposed in the legislature must be approved by a majority vote of each house in two successive sessions of the legislature. An amendment must then be approved by a majority of the voters in an election.

The question of calling a constitutional convention must be submitted to the voters every 10 years. Approval by a majority of the people voting on the proposition is needed to call a convention. Amendments that are proposed by a constitutional convention also need the approval of a majority of the people who are voting on the issue.

Executive. The governor of Iowa is elected to a four-year term and can serve an unlimited number of terms. The governor has the power to veto legislation. But a two-thirds vote in each house of the legislature can override the veto. The governor may also veto parts of a bill that deal with money, and sign the rest of the bill into law. The governor appoints the officers of about 20 state agencies and departments. Other appointments must be approved by the state Senate. The other high executive officials are elected to four-year terms.

Legislature of Iowa, called the General Assembly, consists of a 50-member Senate and a 100-member House of Representatives. Voters in each of Iowa's 50 senatorial districts elect 1 senator. Voters in each of the 100 representative districts elect 1 representative. Senators serve four-year terms, and representatives serve two-year terms. The two houses of the state legislature

The governors of Iowa

	Party	Term		Party	Term
Ansel Briggs	Democratic	1846-1850	**George W. Clarke**	Republican	1913-1917
Stephen P. Hempstead	Democratic	1850-1854	**William L. Harding**	Republican	1917-1921
James W. Grimes	Whig	1854-1858	**N. E. Kendall**	Republican	1921-1925
Ralph P. Lowe	Republican	1858-1860	**John Hammill**	Republican	1925-1931
Samuel J. Kirkwood	Republican	1860-1864	**Daniel W. Turner**	Republican	1931-1933
William M. Stone	Republican	1864-1868	**Clyde L. Herring**	Democratic	1933-1937
Samuel Merrill	Republican	1868-1872	**Nelson G. Kraschel**	Democratic	1937-1939
Cyrus C. Carpenter	Republican	1872-1876	**George A. Wilson**	Republican	1939-1943
Samuel J. Kirkwood	Republican	1876-1877	**Bourke B. Hickenlooper**	Republican	1943-1945
Joshua G. Newbold	Republican	1877-1878	**Robert D. Blue**	Republican	1945-1949
John H. Gear	Republican	1878-1882	**William S. Beardsley**	Republican	1949-1954
Buren R. Sherman	Republican	1882-1886	**Leo Elthon**	Republican	1954-1955
William Larrabee	Republican	1886-1890	**Leo A. Hoegh**	Republican	1955-1957
Horace Boies	Democratic	1890-1894	**Herschel C. Loveless**	Democratic	1957-1961
Frank D. Jackson	Republican	1894-1896	**Norman A. Erbe**	Republican	1961-1963
Francis M. Drake	Republican	1896-1898	**Harold E. Hughes**	Democratic	1963-1969
Leslie M. Shaw	Republican	1898-1902	**Robert D. Fulton**	Democratic	1969
Albert B. Cummins	Republican	1902-1908	**Robert D. Ray**	Republican	1969-1983
Warren Garst	Republican	1908-1909	**Terry E. Branstad**	Republican	1983-1999
Beryl F. Carroll	Republican	1909-1913	**Tom Vilsack**	Democratic	1999-

Iowa General Assembly

The Iowa House of Representatives meets in the State Capitol in Des Moines. Each of its 100 members is elected to a two-year term.

meet regularly each year beginning on the second Monday in January. The legislature meets for 110 days and 100 days in alternate years. Special sessions of the legislature may be called by either the legislature itself or by the governor.

Courts. The highest court in Iowa is the Supreme Court. It has seven justices, who serve eight-year terms. The justices select one of their number to be chief justice. Iowa also has a court of appeals that has statewide jurisdiction. The court of appeals has nine judges, who serve six-year terms. The judges choose one of their number to serve as chief judge. In addition, each of Iowa's eight judicial districts has a district court that has from 7 to 28 judges. The district judges serve six-year terms. They appoint district associate judges, who handle less important cases. These judges serve four-year terms.

The governor appoints Iowa's Supreme Court justices and district judges from lists of persons nominated by the State Judicial Nominating Commission. After serving in office for a certain period, a judge must receive the voters' approval to serve a full term.

Local government. Each of Iowa's 99 counties is governed by a board of supervisors. In most counties, the board consists of three members elected to four-year terms. Most cities have the mayor-council form of government and many have a council-manager system. In 1968, the state Constitution was amended to grant *home rule* to Iowa cities. That is, the cities operate under their own charters. Four cities are governed under charters granted before the present Constitution was adopted. These cities are Camanche, Davenport, Muscatine, and Wapello. In 1978, the state Constitution was amended to grant home rule to Iowa's counties.

Revenue. Taxation provides about 50 percent of the state's *general revenue* (income). Much of the rest comes from federal grants and programs. Iowa's revenue system is based largely on sales taxes, personal income taxes, and charges for government services. Other taxes include those on corporations, insurance, motor fuels, and motor vehicle licenses.

Politics. The Democratic Party controlled Iowa politics when the state entered the Union in 1846. During the 1850's, many Iowa Democrats became dissatisfied with their party for not opposing slavery. They joined with members of the Whig Party to help form the Republican Party. A Republican became governor of Iowa in 1858. Since then, the Republican candidate has defeated the Democratic candidate in most of Iowa's gubernatorial elections.

For Iowa's electoral votes and voting record in presidential elections, see **Electoral College** (table).

Most of Iowa's Republican strength lies in rural areas, while most Democratic strength is in the cities. Members of both parties seek as much representation as possible from areas where their party is strong. In 1964 and 1965, the state legislative districts were temporarily *reapportioned* (redivided). The reapportionment gave the cities greater representation, which resulted in more Democrats in the legislature. Beginning with the 1970 census, the state has been reapportioned after each U.S. census.

Indian days. The Iowa region was once the home of prehistoric Indians who became known as Mound Builders. They had disappeared long before white people first arrived in 1673. The Indians left more than 10,000 burial mounds containing tools and weapons. See **Mound builders**.

Early explorers found both Woodland and Plains Indians living throughout what is now Iowa. The Illinois, Iowa, Miami, Ottawa, and Sioux lived along the Mississippi River. The Omaha, Oto, and Missouri tribes ranged through the western section. The Indians wandered after the great buffalo herds that provided their chief source of food. Sauk and Fox Indians fled into Iowa after the French forced them out of Wisconsin in 1733.

Exploration and early settlement. Whites first saw the Iowa region on June 17, 1673. Two French explorers, Louis Jolliet and Father Jacques Marquette, paddled their canoes down the Wisconsin River into the Mississippi River. They landed on the Iowa side on June 25. In 1680, Robert Cavelier, Sieur de La Salle, sent Michel Aco and Father Louis Hennepin to explore the upper Mississippi River. They passed by the Iowa shore. La Salle went down the river and reached the mouth of the Mississippi in 1682. He claimed for France the entire region drained by the river. La Salle named the region *Louisiana,* in honor of King Louis XIV.

During the rest of the 1600's and the early 1700's, only a few missionaries, soldiers, and fur traders visited the Iowa region. In 1690, Nicholas Perrot taught the Miami Indians how to mine the lead in what is now the Dubuque area. But no permanent white settlements were made.

In 1762, France gave Spain control of the Louisiana region west of the Mississippi River. Julien Dubuque, a French-Canadian adventurer, received permission from the Fox Indians in 1788 to mine lead near present-day Dubuque. He became Iowa's first white settler and stayed until his death in 1810. Several other trappers and hunters came soon after Dubuque.

Territorial days. In 1800, Spain agreed to return its part of Louisiana, including the Iowa region, to France. Iowa became part of the United States in 1803 as part of the Louisiana Purchase (see **Louisiana Purchase**). In 1805, the federal government created the Territory of Louisiana, which included the Iowa region. Meriwether Lewis and William Clark explored the territory from 1804 to 1806. While traveling up the Missouri River, Charles Floyd, a member of the expedition, died. Buried at what is now Sioux City, Floyd was the first white man known to be buried in Iowa. Zebulon M. Pike explored the Mississippi River in 1805 and 1806 and visited Julien Dubuque's settlement. The U.S. Army built Iowa's first fort, Fort Madison, in 1808.

Congress reorganized the Iowa region as a part of the Territory of Missouri in 1812, when Louisiana became a state. Fur companies established posts on the Des Moines, Mississippi, and Missouri rivers during the early 1800's. But the region remained Indian land, officially closed to permanent settlement. Missouri gained statehood in 1821, and Iowa became part of the unorganized territory of the United States.

By 1831, the federal government had forced most of the Sauk and Fox Indians to move from Illinois into the Iowa region. The government wanted to make room for pioneers in western Illinois. But Chief Black Hawk refused to live in Iowa. The Black Hawk War of 1832 broke out, and white troops defeated the Indians. The tribes agreed to move out of a strip of land in Iowa that was 50 miles (80 kilometers) wide and extended along the Mississippi River. It became known as the Black Hawk Purchase, and many settlers promptly moved into it. The region was attached to the Territory of Michigan in 1834 for purposes of government.

In 1836, Congress created the Territory of Wisconsin,

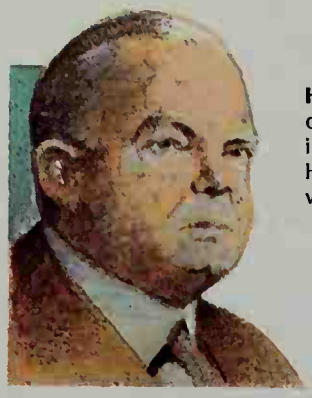
Putnam Museum

Davenport in 1866 was a thriving Mississippi River port. Steamboats and railroads brought people, supplies, and industry to Iowa during the middle and late 1800's.

Historic Iowa

The Keokuk Dam, along the Mississippi River in southern Iowa, was completed in 1913. It helped provide power for cities as far away as St. Louis.

The Black Hawk War broke out in 1832. U.S. troops forced Chief Black Hawk and the Sauk and Fox Indians out of a strip of land in Iowa 50 miles (80 kilometers) long.



Herbert Hoover, the 31st President of the United States, was born in West Branch on Aug. 10, 1874. He was the first President born west of the Mississippi River.

Julien Dubuque, a French-Canadian adventurer, received permission from the Fox Indians to mine lead near present-day Dubuque in 1788. He became Iowa's first white settler.

The first railroad to cross Iowa was completed in 1867 from Clinton to Council Bluffs. By 1870, four railroads were running across the state.

WORLD BOOK illustrations by Kevin Chadwick

Important dates in Iowa

1673 Louis Jolliet and Jacques Marquette of France became the first white people to see the Iowa region.

1762 France ceded part of its colony of Louisiana, including Iowa, to Spain.

1788 Julien Dubuque, Iowa's first white settler, began mining lead near present-day Dubuque.

1800 Spain ceded the Louisiana region back to France.

1803 The U.S. acquired Iowa in the Louisiana Purchase.

1808 The U.S. Army built Fort Madison.

1832 Indians led by Chief Black Hawk were defeated by the U.S. Army in the Black Hawk War.

1833 Permanent settlements began in the Iowa region.

1834 Congress attached the area to the Territory of Michigan for governmental purposes.

1836 Congress created the Territory of Wisconsin, which included Iowa, Minnesota, and most of the Dakotas.

1838 Congress created the Territory of Iowa.

1846 Iowa became the 29th state on December 28.

1857 The legislature adopted Iowa's present Constitution.

1867 The first railroad was completed across Iowa, from the Mississippi River to Council Bluffs.

1873 Grange members opposed the practices of railroads serving farmers and won control of the legislature.

1913 The Keokuk Dam was completed.

1917 Iowa began an extensive road-building program.

1920's-1933 Many Iowa farmers lost their land through failure to make mortgage payments.

Mid-1930's-1940's Legislation was passed to help Iowa farmers.

1962 The Iowa court system was reorganized.

Mid-1970's Manufacturing overtook agriculture as a source of income in Iowa.

1985 The state established a lottery to raise revenue.

1993 Floods caused more than $2 billion in property and crop damage in Iowa.

which included the Black Hawk Purchase. On June 12, 1838, Congress separated the land west of the Mississippi River from the Wisconsin Territory. The Territory of Iowa was created on July 4, 1838. This new territory included all of present-day Iowa, most of Minnesota, and two-thirds of North and South Dakota. President Martin Van Buren appointed Robert Lucas as the first territorial governor. The capital was at Burlington. It was moved to Iowa City in 1841.

Statehood. As early as 1839, Governor Lucas proposed steps to make Iowa a state, but the voters opposed statehood. As long as the region remained a territory, they did not have to pay the salaries of local officials. But if the region became a state, these salaries would have to be paid from local taxes.

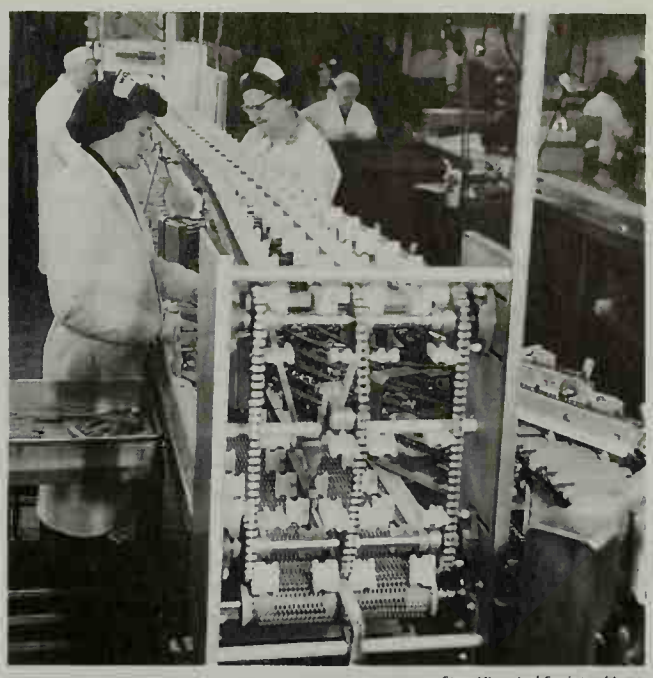
The voters finally approved a constitutional convention in 1844, in preparation for statehood. But Congress rejected the state boundaries set forth in the proposed Iowa constitution. In turn, the voters opposed the boundaries proposed by Congress. A second constitutional convention met in 1846. It adopted Iowa's present boundaries. The voters approved the new Constitution on August 3. President James K. Polk signed a bill admitting Iowa to the Union as the 29th state on Dec. 28, 1846. The new state had a population of 102,338. Ansel Briggs, a Democrat, became the first governor of Iowa.

Iowa adopted its present Constitution in 1857. Under this Constitution, the capital was moved to Des Moines. That year, a band of Sioux Indians massacred settlers at Spirit Lake in western Iowa. Many Iowans feared that the massacre would discourage further settlement in the area. But settlers continued to arrive in large numbers. Most of them opposed slavery, and Iowa supported the Union during the Civil War (1861-1865).

The coming of the railroads. In 1867, the first railroad crossed Iowa, from the Mississippi River to Council Bluffs. By 1870, four railroads crossed Iowa. Iowa farmers became angry. They felt the railroads charged unfair rates for freight. Iowa members of the Grange, a national farmers' organization, supported the Anti-Monopoly party in 1873 and gained control of the state legislature. In 1874, the legislature adopted a series of laws that regulated freight rates in the state. The railroads managed to get these laws repealed in 1878. A commission appointed by the state then drew up rates acceptable to both sides.

Steamboating became a giant industry on the Mississippi River between 1850 and 1870. During this period, lumber companies in Wisconsin and Minnesota sent huge rafts of logs down the Mississippi. The states along the river used the logs as lumber. This ready supply of lumber changed Iowa from a region of log cabins and sod houses to one of frame houses. During the early 1900's, the railroads provided new markets for industries, and new dams provided power. The Keokuk Dam, completed in 1913 on the Mississippi River, helped develop industries as far away as St. Louis, Mo.

The temperance movement had developed in Iowa during the 1830's and became quite strong. Territorial Governor Lucas supported the movement, which opposed the manufacture and sale of alcoholic drinks. In 1855, the state adopted its first law prohibiting the sale of these beverages. The legislature passed an even stricter law in 1885. This law was replaced by the less



State Historical Society of Iowa

Manufacturing Industry grew in Iowa in the mid-1900's, and meat processing became a key industry. The women above worked on a frankfurter machine at a plant in Cedar Rapids.

strict Mulct Law in 1894. The Mulct Law allowed counties to decide for themselves whether to allow the sale of alcoholic beverages. By 1906, 43 of the 99 counties allowed taverns to operate. The Mulct Law was repealed in 1915. Five years later, in 1920, nationwide prohibition of liquor went into effect.

The early 1900's. Iowa began an extensive road-building program in 1917. The United States entered World War I that year. Private Merle Hay of Glidden was one of the first three American soldiers killed, and France erected a monument in his honor.

Iowa farmland sold at record high prices during the war and after the fighting ended in 1918. Farmers had to take large mortgages in order to buy new land. As early as 1920, many farmers had gone deeply into debt. By 1929, when the Great Depression began, many had lost their land through failure to pay their mortgages. Federal and state legislation was passed in the mid-1930's to help Farmers. In 1936, many farmers became members of farm cooperatives. They hoped to save money by joining together to buy supplies and to sell their crops. These cooperatives and the new legislation helped many farmers in Iowa keep their land.

In 1933, after the prohibition of liquor was repealed, Iowa's legislature passed a law allowing beer to be sold in retail stores. The next year, the state set up a system of state-owned stores to sell other alcoholic beverages. But no alcoholic drinks could be served in taverns.

The mid-1900's. During World War II (1939-1945), the demand increased for American farm products, including corn and pork from Iowa. As a result, the income of Iowa farmers rose rapidly.

Between 1945 and the late 1960's, hundreds of new industries moved into Iowa. Most of them were food or metal processors or machinery manufacturers. Iowa thus began to shift from a basic farm economy to an industrial-agricultural economy. Meanwhile, the in-

creased use of modern farm machinery and the merging of small farms into larger ones reduced farm employment. Many Iowans moved from rural areas to cities to work in the new and expanding industries. The 1960 census reported that, for the first time, more Iowans lived in urban areas than in rural areas. The census showed that 53 percent of the people lived in cities and towns, compared with 48 percent in 1950.

The issue of liquor sales arose again during the 1950's. The Iowa legislature rejected several resolutions to permit alcoholic drinks to be served in taverns. In 1963, the legislature legalized the sale of liquor by the drink. But the voters in each of Iowa's counties can decide whether to permit the sale of liquor in their areas.

The late 1900's. Manufacturing continues to increase in value in Iowa. During the mid-1970's, manufacturing overtook agriculture as a source of income.

During the first half of the 1980's, Iowa's farming industry hit hard times because of low agricultural prices, high interest rates, and a worldwide food surplus. These developments and a reduction of federal agricultural price supports, which guarantee certain price levels for farm products, contributed to a sharp decline in land values. Part-time farming increased by farmers who needed to hold other jobs to add to their farm income. Some farmers went bankrupt, and a number of banks serving rural areas failed. In addition, the drop in agricultural prices hurt many Iowa industries associated with agriculture, especially those that make machinery, hybrid seed, and fertilizer.

The farm slump seriously affected Iowa's small towns and rural areas. Many young people left Iowa to work elsewhere. The 1990 census showed that Iowa's population dropped by 4 $\frac{1}{2}$ percent during the 1980's. In the last half of the 1980's, the downward trend began to level out. Farm values rebounded, and migration out of Iowa declined. Iowa's leaders have worked to diversify the agricultural industry and expand manufacturing activities. But Iowa remains largely dependent on agriculture.

In 1989, the government legalized riverboat gambling in Iowa. The state hoped to spur economic development through tourism, particularly in cities along the Mississippi River. Such cities as Davenport, Dubuque, and Fort Madison offer riverboat gambling.

Iowa sometimes suffers from flooding along its rivers, including the Mississippi, Missouri, and Des Moines. In 1993, floods that resulted from heavy rains damaged more than $2 billion worth of property and crops.

The early 2000's. Iowa's population in 2000 showed an increase over what it was in 1990. According to the 2000 census, the state's population grew by 5 $\frac{1}{2}$ percent during the 1990's.

Robert E. Clark and Malcolm J. Rohrbough

Study aids

Related articles in *World Book* include:

Biographies

Black Hawk
Borlaug, Norman
Buffalo Bill
Catt, Carrie C.
Dubuque, Julien
Harlan, James
Hoover, Herbert C.
Hopkins, Harry L.
Jolliet, Louis
Kirkwood, Samuel J.
Leopold, Aldo
Lewis, John L.
Mansfield, Arabella Babb
Marquette, Jacques
Van Allen, James A.
Wallace, Henry A.
Wood, Grant

Cities

Cedar Rapids
Davenport
Des Moines
Dubuque
Sioux City

History

Amanites
Iowa Indians
Louisiana Purchase
Mound builders
Sauk Indians
Westward movement in America

Physical features

Effigy Mounds National Monument
Mississippi River
Missouri River

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VI. History

Questions

What are the chief crops of Iowa?
What caused the Black Hawk War?
What was one of the first U.S. public schools for children with physical disabilities?
What are some common hardwood trees in Iowa?
Which president of the United States was born in Iowa?
What is Iowa's leading service industry?
Which river system forms Iowa's eastern and western borders?
Why is Iowa called the *Hawkeye State*?
When did the United States census report that, for the first time, more Iowans lived in urban areas than in rural areas?
Where is the nation's largest popcorn-processing plant?

Additional resources

Level I

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Level II

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Bergman, Marvin, ed. *Iowa History Reader.* Ia. State Univ. Pr., 1996.
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Iowa, University of, is a state-supported, coeducational research university in Iowa City, Iowa. It has colleges of business administration, dentistry, education, engineering, law, liberal arts, medicine, nursing, and

pharmacy. It also has a graduate college. The university grants bachelor's, master's, and doctor's degrees. The liberal arts college includes about 35 academic departments. In addition, the college has schools of art and art history, journalism and mass communication, letters, library and information science, music, religion, and social work.

The university pioneered in the fields of speech pathology and educational testing. It ranks as a leading center of study in these areas and in hydraulics, space physics, communication, writing, and such medical specialties as cardiology and Alzheimer's disease. The university is noted for its writer's workshop and other programs in arts and letters. The University of Iowa is also a center for studying such technologies as laser analysis and biomechanics.

The university's hospitals and clinics make up the largest university-owned teaching hospital in the United States. It has 1,100 beds and a staff of about 1,000 physicians and dentists. The hospital serves patients who need unusual or highly specialized health care, and it also helps train students for medical careers.

James A. Van Allen and other university physicists played a major part in the study of radiation in outer space. They used balloons, rockets, satellites, and other spacecraft in their research (see **Van Allen belts**).

The University of Iowa was founded in 1847. It opened in 1855. Critically reviewed by the University of Iowa

Iowa Indians were a small Plains tribe of the United States. They used to live in the Midwestern state that was named after them. The name meant "sleepy ones" in the language of their Sioux enemies.

The Iowa Indians combined farming with buffalo hunting. They were related in language and customs to the nearby Oto and Missouri tribes. According to tradition, these three tribes migrated southward from the Great Lakes region. These Indians measured their wealth in buffalo hides and finely carved *calumets* (tobacco pipes).

An early French trader spoke of the Iowa Indians as "industrious and accustomed to cultivate the earth." The Iowa carried tepees on hunting trips on the Plains, but their settlements had dome-shaped houses of bent poles covered with bark. R. David Edmunds

Iowa State University of Science and Technology is a coeducational land-grant school in Ames, Iowa. The university has colleges of agriculture, business administration, design, education, engineering, family and consumer sciences, liberal arts and sciences, and veterinary medicine and also a graduate college. The university grants bachelor's, master's, and doctor's degrees.

There are 19 research and service agencies at the university. These agencies include the Ames Laboratory of the United States Department of Energy, the Center for Agricultural and Rural Development, and the World Food Institute.

The school was chartered in 1858 as Iowa Agricultural College, and it opened in 1868. Its name was changed to Iowa State College of Agriculture and Mechanic Arts in 1896. It received its present name in 1959.

Critically reviewed by Iowa State University of Science and Technology

See also **Iowa** (picture: Iowa State University).

Ipecac, *IHP uh kak,* is a drug made from the dried root of a small shrub native to Brazil. It contains *emetine,* an organic compound that causes a person who takes the drug to vomit.

Ipecac is sometimes used to treat victims of poisoning. But it should only be used at the recommendation of a physician, pharmacist, or poison control center. This is because inducing vomiting in people who have swallowed certain poisons can have further toxic effects.

Barbara M. Bayer

See also **Emetic; First aid** (Swallowed poisons).

Iphigenia, *IHF uh juh NY uh,* in Greek mythology, was the daughter of Clytemnestra and Agamemnon, the commander of the Greek forces in the Trojan War. Agamemnon sacrificed Iphigenia to the goddess Artemis so that the goddess would send the Greek fleet favorable winds for their voyage to Troy.

One version of the myth tells that Iphigenia died during the sacrifice. According to another version, Artemis rescued Iphigenia, substituting a deer in her place. The goddess carried Iphigenia to the land of Tauris, where she became a priestess of Artemis. Orestes, Iphigenia's brother, later murdered Clytemnestra. As punishment, the god Apollo ordered him to go to Tauris and bring back a sacred wooden statue of Artemis. The Taurians, who sacrificed all outsiders, captured Orestes, but Iphigenia recognized her brother and saved him. Under the protection of the goddess Athena, Iphigenia and Orestes escaped from Tauris with the statue. Iphigenia again became a priestess of Artemis after she returned to Greece. F. Carter Philips

IPO. See **Initial public offering.**

IQ. See **Intelligence quotient.**

Iqaluit, *ee KAH loo iht* (pop. 5,236), is the capital and largest town of the Canadian territory of Nunavut. Iqaluit lies on the southern coast of Baffin Island. For location, see **Nunavut** (map). During the winter, Iqaluit receives only four to six hours of daylight, and temperatures can drop to as low as −49 °F (−45 °C). Winter also brings frequent strong winds and blizzards to the town.

Inuit have fished and hunted in the area of Iqaluit for hundreds of years. The town's name in Inuktitut, an Inuit language, means *place of fish.* Today, Inuit make up about two-thirds of the population of Iqaluit. Many of the town's residents still hunt or fish regularly for food as well as for pleasure.

In 1576, Sir Martin Frobisher, an English explorer, became the first European to see Baffin Island. In 1942, during World War II, the United States Army Air Forces established a landing strip in the area. In 1980, Iqaluit was incorporated as a town called Frobisher Bay. The town officially adopted its present name in 1987.

Jeff Gilmour

See also **Nunavut** (picture).

Iqbal, *ihk BAHL,* Sir Muhammad (1873-1938), a Muslim Indian scholar, philosopher, and poet, is regarded as the spiritual founder of Pakistan. He urged political and spiritual unity of all the Muslim peoples. He tried to reformulate the basic ideas of Islamic theology in the spirit of European philosophy. His poetry includes *Secrets of the Self* (1920) and *Jawid Nama, The Book of Eternity* (1932). His *Mysteries of Selflessness* was published in 1953 after his death. Iqbal was born in what is now Sialkot, Pakistan, on Nov. 9, 1873. Richard C. Martin

IRA. See **Irish Republican Army.**

IRA. See **Pension** (Individual retirement accounts).

Persian mosque (early 1600's); Georg Gerster, Photo Researchers

A beautiful blue-domed mosque (Islamic house of worship) symbolizes the importance of the Islamic faith in Iran. Nearly all Iranians are Muslims. This is the Imam Mosque in Isfahan, Iran.

Iran

Iran, *ih RAHN* or *ih RAN,* is an ancient country in the Middle East region of southwestern Asia. It is a land of snow-capped mountains, green valleys, and barren deserts. Tehran is the country's capital and largest city.

Iran is one of the world's oldest countries. Its history dates back almost 5,000 years and includes the days of the great Persian Empire. In Biblical times, Persian kings ruled a vast territory that included most of southwestern Asia and parts of Europe and Africa. For the story of this early civilization, see **Persia, Ancient.**

Foreign powers have invaded and occupied Iran time and again during its long history. One of the most important invasions occurred in the mid-600's, when Muslim Arabs conquered the country. The Arab conquest had a lasting effect on Iranian culture. The Muslim *caliphs* (religious leaders) governed the country for about 200 years. During their rule, the Islamic faith spread throughout Iran. Today, the vast majority of Iranians are Muslims.

In the early 1900's, the discovery of oil in southwestern Iran gave the country an enormous source of wealth. Reza Shah Pahlavi ruled Iran as *shah* (king) from 1925 to 1941. In 1941, his son, Mohammad Reza Pahlavi, became shah. Both men used revenues from Iran's oil exports to modernize the country and promote economic and social development. In 1979, revolutionaries under Ayatollah Ruhollah Khomeini, a Muslim religious leader, overthrew the regime of Mohammad Reza Pahlavi and took control of Iran. The revolutionaries changed Iran's government from a constitutional monarchy to an Islamic republic. Their policies led to strict Islamic control over all areas of people's lives and resulted in severe economic problems for the nation and strained relations between Iran and Western countries.

Ali Banuazizi, the contributor of this article, is Professor of Cultural Psychology and Modern Iranian History at Boston College.

Facts in brief

Capital: Tehran.
Official language: Persian, also called Farsi.
Official name: Jomhuri-ye Eslami-ye Iran (Islamic Republic of Iran).
Area: 630,577 mi² (1,633,188 km²). *Greatest distances*—northwest-southeast, 1,375 mi (2,213 km); northeast-southwest, 850 mi (1,370 km). *Coastline*—1,650 mi (2,655 km).
Elevation: *Highest*—Mount Damavand, 18,386 ft (5,604 m) above sea level. *Lowest*—92 ft (28 m) below sea level along the Caspian Sea.
Population: *Estimated 2002 population*—69,049,000; population density, 110 per mi² (42 per km²); distribution, 63 percent urban, 37 percent rural. *1996 census*—60,055,000.
Chief products: *Agriculture*—wheat, sugar beets, rice, barley, nuts. Fishing—caviar. *Manufacturing*—petroleum products, textiles, cement, brick, food products. *Mining*—petroleum.
National anthem: "Soroude Jomhuri-ye Eslami-ye Iran" ("Anthem of the Islamic Republic of Iran").
Money: *Basic unit*—rial. Ten dinars equal one rial. See also **Rial.**

Government

After the 1979 revolution, Ayatollah Khomeini and his followers, who included many other religious leaders, drafted a Constitution for the new Islamic republic. The Constitution, which is closely based on the teachings of Islam, went into effect in December 1979. Under the Constitution, the nation's supreme leader is the *faqih,* a scholar in Islamic law and the recognized religious leader of most Iranians. The Constitution named Khomeini the first ruling faqih of the Islamic republic. It granted him tremendous powers and placed him above all other government officials. Khomeini held the position of faqih until his death in 1989. He was succeeded by Ayatollah Ali Khamenei, who is referred to as the "Spiritual Guide"—or more formally as the "Supreme Guide"—of the nation.

National government. Iran's Constitution provides for three branches of government—executive, legislative, and judicial. Members of the Islamic clergy hold many important positions in all three branches.

A president heads the executive branch of Iran's government. The people elect the president to a four-year term. The president and a Cabinet carry out government operations. The president chooses Cabinet members.

The lawmaking branch of the Iranian government consists of two elected bodies and two appointed ones. The elected bodies are the Islamic Consultative Assembly (Majlis) and the Assembly of Experts. The Majlis serves as the main legislative body of the government. Its 290 members are elected by voters to four-year terms. The Assembly of Experts prepares any changes to the Constitution and elects the successor to the position of the Supreme Guide.

The appointed bodies of the lawmaking branch of the Iranian government are the Council of Guardians and the Discretionary Council. The Council of Guardians consists of six lawyers and six judges. It reviews all new laws to ensure that they do not violate Islamic principles or the Constitution. The Discretionary Council appoints the lawyers to the Council of Guardians, and the Supreme Guide names the judges. The Discretionary Council rules on legal and theological disputes between the Majlis and the Council of Guardians.

Iran's flag and coat of arms were adopted by the Islamic government in 1980. The inscription *God Is Great* appears in Arabic 11 times on both the green stripe and the red stripe of the flag. The white stripe bears the coat of arms, which is the word *Allah* (the Arabic name for God) drawn in formal Arabic script.

WORLD BOOK map

Iran lies in southwestern Asia, north of the Persian Gulf. It is bordered by seven countries.

Local government. Iran is divided into 24 *ostans* (provinces) for purposes of local government. Each ostan has a governor appointed by the national government and a council elected by the ostan's voters. Ostans are further divided into counties, districts, cities, towns, and villages, each of which has its own system of government. The local governments are largely controlled by the national government.

Politics. The government does not allow any formal political parties to operate freely in Iran today. However, various loosely organized groups and associations take part in election campaigns and other political activities. All candidates must be officially approved by the Iranian government before they can run for office. All Iranian citizens 15 years of age or older may vote.

The best-known opposition group to the government is the Iran Liberation Movement. This organization has worked for democracy and human rights by peaceful methods for a number of years. Several opposition groups consist of Iranians who live outside Iran. These groups include the Islamic-socialist *Mojahedin-e Khalq* (People's Holy Warriors) and groups that seek a democratic and *secular* (nonreligious) government for the country.

Courts. The judicial branch of the Iranian government consists of a five-member Supreme Court, as well as lower civil and criminal courts. Special *clerical courts* try members of the clergy, and *revolutionary tribunals* hear suits concerning offenses said to be against the Islamic revolution. The powerful head of the judicial branch is appointed by the Supreme Guide. All judges in Iran must be members of the Islamic clergy. They base their decisions on Islamic law.

Armed forces. Iran's military forces consist of the regular armed forces, the Revolutionary Guards, the militia (basij), and the police force. The regular armed forces are made up of an army, navy, and air force. The Revolutionary Guards were established after the Islamic revolution and carry out many of the same functions as the regular military forces. The militia is used mainly to put down violent challenges to the government. The police force handles routine security duties.

People

About 70 percent of Iran's land—chiefly mountain and desert regions—is almost uninhabited. Most of the Irani-

Iran map index

Cities and towns

Abadao	206,073	E	2
Abar	78,076	A	2
Ahvaz	804,980	D	2
Amol	159,092	B	3
Arak	380,755	C	3
Ardabil	340,386	B	2
Babol	158,346	B	3
Bakhtarao	692,986	C	2
Baodar-e Abbas	273,578	F	5
Baodar-e Aozali	98,544	B	2
Bandar-e Mashur	88,394	E	2
Behbehao	88,213	E	3
Birjand	127,608	D	6
Bojoord	134,835	B	5
Borazjan	80,161	E	3
Borujerd	217,804	C	2
Bokao	120,020	B	1
Boshehr	143,641	E	3
Dezful	202,639	D	2
Dorud*	88,152	C	2
Emamshahr	104,765	B	4
Eslamabad*	81,641	C	3
Fasa	81,706	E	4
Gonbad-e Kavus	112,253	B	4
Gorgan	188,710	B	4
Hamadan	401,281	C	2
Ilam	126,346	C	1
Isfahao	1,266,072	D	3
Islam Shahr	265,450	C	3
Izeh*	81,288	D	2
Jahrom	94,185	F	4
Karaj	940,968	C	3
Kashao	201,372	C	3
Kazeruo	81,713	E	3
Kerman	384,991	E	5
Khomeini Shahr	165,888	D	3
Khorramabad	272,815	D	2
Khorramshahr	105,636	E	2
Khvoy	148,944	A	1
Mahabad	107,799	B	1
Malayer	144,373	C	2
Maragheh	132,318	B	1
Marand	96,396	A	1
Marv Dasht	103,579	E	4
Masjed Snleymao	116,882	D	2
Meshed	1,887,405	B	6
Miaodowab	90,141	B	1
Mianeh	78,104	B	2
Nahavand	65,164	B	2
Najafabad	178,498	D	3
Neyshabur	158,847	B	6
Orumiyeh	435,200	B	1
Qaemshahr	143,286	B	4
Qazvin	291,117	B	3
Qom	777,677	C	3
Qomsheh	89,779	D	3
Quchan	85,750	B	6
Rafsaojan	98,257	E	5
Rasht	417,748	B	3
Sabzevar	170,738	B	5
Saidabad	135,024	E	5
Sanandaj	277,808	C	2
Saqqez	115,394	B	1
Sari	195,882	B	4
Saveh	111,245	C	3
Semnao	91,045	C	4
Shahr Kord	100,477	D	3
Shiraz	1,053,025	E	3
Shosh	52,058	D	2
Shushtar	77,900	D	2
Tabriz	1,191,043	B	1
Tehran	6,758,845	C	3
Torbat-e Heydariyeh	94,647	C	6
Varamineh	107,233	C	3
Yazd	326,776	D	4
Zabol	100,887	D	7
Zahedao	419,518	E	6
Zaojao	286,295	B	2

Physical features

Arabiao Sea	G	7
Aras River	A	2
Atrek River	B	5
Bampur River	F	6
Bashakerd Raoge	F	6
Caspian Sea	A	3
Dasht-e Kavir (desert)	C	4
Dasht-e Lot (desert)	D	5
Daryacheh-ye Namak (lake)	C	3
Dez River	D	2
Elburz Moootains	B	3
Gorgao River	B	4
Golf of Omao	G	5
Halil River	F	5
Hamuo-e Jaz Murian (lake)	F	6
Hamuo-e Saberi (lake)	D	6
Harirud River	C	7
Karkheh River	D	2
Karuo River	D	3
Kashaf River	B	6
Kavir-e Namak (lake)	C	5
Kharg Islaod	E	3
Khozistao (plain)	D	2
Kol River	F	5
Lake Urmia	B	1
Lavao Island	F	4
Maod River	F	3
Moont Damavand	B	3
Namakzar-e Shahdad (lake)	E	6
Persiao Golf	F	3
Persepolis (ruio)	E	4
Qareh So River	C	3
Qeys Island	F	4
Qeshm Island	F	5
Qizil Uzoo River	B	2
Safid River	B	3
Shatt al Arab River	E	2
Silop River	G	7
Sirri Islaod	G	4
Sirvao River	C	1
Sistan Marsh	E	6
Strait of Hormoz	F	5
Sosa (ruio)	D	2
Zagros Moootains	C	2
Zahreh River	E	3
Zayandeh River	D	3

*Not on map; key shows general location.
Source: 1996 census.

N. Faridani, Stockphotos

A crowded bazaar has tiny shops and stalls where Iranian merchants sell food, metalware, rugs, textiles, and many other goods. Most cities and towns in Iran have such a marketplace.

ans live along the Caspian Sea; in the northwestern provinces; and in the capital city Tehran and its surrounding area.

Ancestry. About two-thirds of the Iranian people are descendants of an Asian people called Aryans. Tribes of Aryans began migrating to Iran from the plains of central Asia during the 1500's B.C.

Persians, the largest ethnic group of Aryan origin, make up about 60 percent of Iran's population. Most Persians live in central Iran and on the slopes of the surrounding mountains. Other ethnic groups believed to be descended from the Aryans include the Gilanis and Mazandaranis of the north, the Kurds of the northwest, the Lurs and Bakhtiaris of the west, and the Baluchis of the southeast.

Other Iranian ethnic groups include the Azerbaijanis, the Khamseh, the Qashqais, and the Turkomans. Some Arabs, Armenians, Assyrians, and Jews also live in Iran.

Since the revolution, Iran's leaders have faced a number of protests from ethnic groups that want greater political and cultural independence. From time to time, fighting has broken out between government troops and members of such groups as Baluchis, Kurds, and Turkomans.

Language. The official language of Iran is Persian, also called Farsi. Persian belongs to the Indo-European family of languages (see **Language** [Indo-European]). It has borrowed many words from Arabic, an Afro-Asian language. It is written in the Arabic script.

Persian is used in schools and in all official communications by the Iranian government. Most of the people speak Persian, either as their native tongue or as a second language. Spoken Persian has several local dialects, which differ greatly in pronunciation. Other languages spoken in Iran include Arabic, Baluchi, Kurdish, and Azeri-Turkish.

Way of life

The Islamic government strongly influences the Iranian way of life. It restricts freedom of speech and other civil rights. It bans all forms of entertainment that it considers to be un-Islamic. The government also requires schools to stress the teachings of Islam. In addition, the government subjects Iranian women to an especially strict code of dress and public behavior.

City life. Many cities in Iran have an older, traditional section and a modern section. Blue-domed *mosques* (Islamic houses of worship) stand in the older sections. Most traditional sections also have a bazaar, where merchants sell food, handmade products, and other goods. The bazaar spreads out in a network of narrow passageways lined with tiny shops and stalls. Domed brick roofs

Philippe Ledru, Sygma

A boulevard in Tehran is lined with fashionable shops and modern apartment and office buildings. Tehran is the capital of Iran and the country's largest city.

over parts of the bazaar protect merchants and customers from sun and rain.

The modern sections of Iran's cities have hospitals, schools, and apartment and office buildings. In the newer districts of the biggest cities, movie theaters, parks, and fashionable shops and restaurants border wide, treelined avenues.

City housing includes modern apartment buildings and traditional Iranian houses. Traditional houses are small mud or brick buildings surrounded by high walls. Each house opens onto a central courtyard decorated with a few trees, flowers, and a small pool of water. Most apartments and houses have Western-style furniture. Persian rugs—handwoven Oriental rugs made in Iran—cover the floors of almost all homes.

Rural life. Most of Iran's rural villages are farming communities in regions that have enough water to grow crops. A typical village centers on a small village square and a wide main street. A mosque and a public bath stand on the square. The only store in many villages is a small grocery. Most villages have no clinic, and only the larger villages have a school.

Most rural families live in one- or two-room traditional houses. The houses are made of mud or unbaked brick and have thatched or flat mud roofs. Simple rugs or felt mats cover the floors. The people sit on cushions and sleep on mattresses on the floor. They eat their meals off a cloth spread out on the floor. Houses in most villages lack electricity and running water.

Some of Iran's rural people are nomads. They travel across the countryside with their sheep, goats, and other livestock to seasonal grazing areas. The nomads live in round, black felt tents. When the nomads travel, they pack all their possessions on the backs of donkeys or camels. See **Nomad**.

Religion. About 99 percent of the Iranian people are Muslims. About 95 percent of them belong to the Shiah branch of Islam, which is the state religion of Iran. Most of the rest belong to the Sunni branch.

About 250,000 Bahá'ís make up Iran's largest religious minority (see **Bahá'ís**). Bahá'ís have never had legal recognition in Iran and are forbidden to practice their faith. Iran also has some Christians, Jews, and followers of an ancient Persian religion called Zoroastrianism (see **Zoroastrianism**). The Islamic government has little tolerance for Iran's religious minorities. Bahá'ís in particular have been severely persecuted.

Photri from Marilyn Gartman Agency

A typical rural village in Iran has small mud or unbaked brick houses surrounded by high walls. Most villages lie in areas of the countryside where there is enough water for farming.

Clothing. Most city dwellers in Iran wear Western-style clothing. Many women in the cities also wear long, usually black, body veils called *chadors* over their other clothes. A woman drapes a chador around her body, across her shoulders, over her head, and sometimes across the lower part of her face. The wearing of a chador is based on Islamic moral teachings. The government strongly encourages women to wear chadors or head coverings. Most men in rural villages dress in rough cotton shirts, baggy black trousers, and sometimes long blue or black cotton coats. Most rural women wear loose blouses and black cotton trousers gathered at the ankles. They cover their heads with scarfs instead of using chadors.

Food and drink. The main foods of the Iranian people are rice and bread. They often mix rice with meat and vegetables or cover it with a thick, spicy sauce. Most Iranians eat bread at every meal. Traditional Iranian dishes include *abgusht* (a thick meat and bean soup); *dolmeh* (vegetables stuffed with meat and rice); and *kebab* (lamb roasted on a skewer). Popular beverages include fruit syrups mixed with water, sweetened tea, and a yogurt drink called *dough*.

Recreation. Iranians spend much of their leisure time visiting one another and entertaining friends and relatives in their homes. They also enjoy a variety of sports, including basketball, soccer, volleyball, and weightlifting. Many men practice a traditional form of weightlifting exercises and gymnastics at athletic clubs called *zurkhanehs*. The word *zurkhaneh* means *house of strength*. Live theater, motion pictures, video cassettes, and television are becoming increasingly popular, especially among young people in the cities.

Iranians celebrate many religious and national holidays. A major holiday is Nowruz, the Iranian New Year. Nowruz begins on the first day of spring. Fifteen days before the new year starts, most families plant wheat or lentil seeds in a shallow bowl. The green sprouts that appear symbolize the coming of spring. On New Year's Eve, families gather for elaborate banquets. People spend the first few days of the Nowruz holidays visiting nearby friends and relatives. On the 13th day of the new year, the last day of the Nowruz celebration, almost all Iranians go on picnics.

Education. The law requires all Iranian children from 7 to 13 years of age to attend school. However, some children still do not do so. Most of these children are girls who live in Iran's rural villages. For Iran's literacy rate, see **Literacy** (table: Literacy rates for selected countries).

Higher education in Iran is offered at several kinds of institutions. These institutions include colleges; universities; and technical, vocational, and teacher-training schools. The Open Islamic University, with branches throughout Iran, has over 300,000 students.

The arts. Iran has long been famous for its architecture, painting, and poetry. Early architects in Iran built magnificent mosques and palaces. They decorated the walls and domes with brightly colored mosaic and tile

Henri Bureau, Sygma

designs. Traditional Persian painting features delicate detail work and jewellike colors.

Three of the greatest Persian poets—Firdausi, Hafiz, and Saadi—lived before 1400. The works of Hafiz are probably the most popular poems in Iran. People sometimes use his *Divan,* a collection of mystical poems, to help plan their lives. They open the book at random and use the first line they see as a guide to action. See **Hafiz; Saadi.**

Gerry Cranham, Photo Researchers

Iranian weightlifters work out in a special athletic club called a *zurkhaneh,* which means *house of strength.* Most cities and towns in Iran have at least one zurkhaneh.

J. Guichard, Sygma

Religious customs are strictly observed by many of Iran's Muslims. At a prayer gathering, *left,* men recite passages from the Quran, the holy book of Islam. Many Iranian women, *above,* follow the tradition of wearing a black, full-length body veil called a *chador.*

Iranian craftworkers make beautiful jewelry, pottery, and metalware. Their handwoven Persian rugs are prized for their graceful patterns and soft colors. The complicated designs of the rugs often require months of labor to complete. Other traditional arts in the country include embroidery, silk weaving, and woodcarving.

The land

Iran lies in southwestern Asia, northeast of the Arabian Peninsula. The country faces Armenia, Azerbaijan, the Caspian Sea, and Turkmenistan on the north and Afghanistan and Pakistan on the east. The Persian Gulf and the Gulf of Oman lie to the south. Iraq and Turkey border Iran on the west.

Iran can be divided into four major land regions. They are (1) the Interior Plateau, (2) the Mountains, (3) the Caspian Sea Coast, and (4) the Khuzistan Plain.

The Interior Plateau lies in central and eastern Iran. It occupies about half the country's total area. The plateau stands about 3,000 feet (900 meters) above sea level and is largely surrounded by mountains. Much of the Interior Plateau consists of two immense, almost uninhabited deserts, the Dasht-e Kavir and the Dasht-e Lut. They are among the most arid and barren deserts in the world. Together, they cover more than 38,000 square miles (98,000 square kilometers).

The Mountains. Two vast mountain ranges—the Elburz and the Zagros—rim most of the Interior Plateau. The Elburz Mountains stand along Iran's northern border. They form a spectacular wall between the Caspian Sea Coast region and the Interior Plateau. Iran's highest peak, Mount Damavand, rises 18,386 feet (5,604 meters) above sea level in the Elburz range. The northern slopes of the Elburz receive plentiful rainfall, and farmers grow a variety of crops on the rich land. The southern slopes of the range are relatively barren and dry.

The Zagros Mountains extend to the south and east from the borders of Turkey and Azerbaijan to the Persian Gulf. Many people live in wide, fertile valleys in the northern and central parts of the range. However, the

R. & S. Michaud, Woodfin Camp, Inc.

Barren wasteland covers much of Iran. Nomads, *shown here,* travel across the countryside with their livestock to seasonal grazing areas. About 70 percent of Iran's land is practically uninhabited. Most of this land consists of deserts and mountains.

extremely dry and rugged southern section is very thinly populated. Smaller mountain ranges lie along the Gulf of Oman and the borders of Afghanistan and Pakistan.

The Caspian Sea Coast is a narrow strip of lowland between the Caspian Sea and the rugged slopes of the Elburz Mountains. A mild climate and abundant, year-round rainfall have made it the most heavily populated region in Iran. Farmers there grow cotton, rice, sugar cane, tea, and other crops on the fertile land.

The Khuzistan Plain lies north of the Persian Gulf, between the border of Iraq and the Zagros Mountains. The region has Iran's richest petroleum deposits. The Khuzistan Plain is also an important agricultural area.

Climate

Iran's climate varies from region to region. Winter temperatures in the mountainous areas of the northwest drop as low as −20° F (−9° C). But the long, severe winters are followed by mild summers. In contrast, the Khuzistan Plain has extremely hot, humid summers with an average temperature of about 95° F (35° C). However, winters on the plain are mild and pleasant.

Most of the Interior Plateau has a very dry climate. Tehran, which lies on the plateau at the foot of the Elburz Mountains, receives only about 9 inches (23 centimeters) of rain a year. Average temperatures in the city range from 35° F (2° C) in January to 85° F (29° C) in July. Winter temperatures drop to freezing in the Dasht-e Kavir and the Dasht-e Lut, but summer temperatures soar as high as 130° F (54° C). An average of about 2 inches (5 centimeters) of rain falls on the deserts yearly.

The Caspian Sea Coast is Iran's only region of abundant rainfall. It receives about 40 inches (100 centimeters) of rain a year. Temperatures in the region seldom rise above 90° F (32° C) or drop below freezing.

N. Farajani, Stockphotos

The Caspian Sea Coast is the most heavily cultivated region in Iran. A mild climate and plentiful rainfall enable farmers to grow a variety of crops on the rich land along the sea.

Economy

The economy of Iran grew rapidly during the 1960's and 1970's. The government, under Shah Mohammad Reza Pahlavi, used part of Iran's enormous oil revenues to finance many new businesses and industries. From 1962 to 1977, Iran's *gross domestic product* (GDP)—that is, the total value of all goods and services produced within the country in a year—multiplied several times.

The revolution of 1979 severely damaged the Iranian economy. Thousands of managers, technicians, and other highly trained workers opposed to the Islamic government left Iran. Many factories closed because of the lack of skilled workers or a shortage of raw materials or machine tools. A war against Iraq during the 1980's and political unrest at home also disrupted the economy. Oil production and exports dropped. The GDP decreased sharply after the revolution.

Service industries account for about 50 percent of Iran's gross domestic product and employ about 46 percent of all workers. These industries include government agencies, hospitals, schools, and other institutions that supply important community services. Banks, insurance companies, restaurants, and many other business

establishments also provide essential business, community, or personal services. Other service industries include trade, transportation, and communication.

Agriculture accounts for about 23 percent of the country's GDP and employs about 28 percent of the workers. Only about one-fourth of the land can be farmed because of a severe water shortage. Iran must import much of its food. Wheat and barley are grown on about 75 percent of the cultivated land. Farmers also raise such crops as corn, cotton, dates and other fruits, lentils, nuts, rice, sugar beets, tea, and tobacco. Cattle, goats, and sheep provide dairy products and meat.

Manufacturing and construction account for about 18 percent of Iran's gross domestic product and employ about 25 percent of all workers. The country's chief manufactured products are brick, cement, food products, petroleum products, and textiles. Iranian factories also produce chemicals, leather goods, machine tools, refined copper, steel, and tobacco products.

Mining accounts for about 9 percent of Iran's gross domestic product and employs about 1 percent of the nation's workers. Petroleum is by far Iran's most important mineral product. The country's oil fields contain about 48 billion barrels of petroleum. The National Iranian Oil Company, which is owned by the government, operates the oil industry. Although petroleum output has decreased sharply since the 1979 revolution, Iran remains one of the world's leading oil producers. It also produces much natural gas. Other minerals in Iran include chromite, coal, copper, iron ore, lead, and zinc. But few of these mineral deposits have been developed.

Fishing industry. The chief product of Iran's fishing industry is the eggs of sturgeon caught in the Caspian Sea. The eggs are used to make a salty delicacy called *caviar*. Iranian fishing crews also catch carp, catfish, whitefish, and white salmon in the Caspian. The Persian Gulf catch includes sardines, shrimp, sole, and tuna.

Trade. Petroleum accounts for more than 90 percent of the total value of Iran's exports. The country also exports caviar, cotton, dried fruits, mineral ores, nuts, and spices. Its leading imports include electric appliances, food, industrial machinery, medicine, and military equipment. Iran's chief trading partners include Germany, Italy, Japan, Spain, Turkey, the United Arab Emirates, and the United Kingdom.

Transportation and communication. Rugged terrain has made it difficult and expensive to develop a modern system of transportation in Iran. Only about a third of the country's roads are paved. Most Iranians travel by bus. In rural areas, bicycles, donkeys, horses, and mules are also important means of transportation. The government owns the country's rail system. Iran Air, a government-owned airline, flies within Iran and to some foreign countries. Tehran has the country's chief airport. Most of Iran's trade is handled by Persian Gulf ports. Kharg Island in the Persian Gulf is the country's chief oil-exporting terminal.

Iran publishes about 25 daily newspapers and more than 300 magazines. It has several radio stations and two major TV stations. All newspapers, magazines, and radio and TV broadcasts are strictly controlled by the government.

History

Early days. The first major civilization in what is now Iran was that of the Elamites, who may have settled in southwestern Iran as early as 3000 B.C. In the 1500's B.C., Aryans began migrating to Iran from central Asia. Eventually, two major groups of Aryans settled in Iran. One group settled in the northwest and founded the Kingdom of Media (see Media). The other group lived in southern Iran, in an area that the Greeks later called *Persis*. The name *Persia* comes from Persis. Both the Medes and the Persians called their new homelands *Iran*, meaning *land of the Aryans*. By the 600's B.C., the Medes had become rulers of the Persians.

The Achaemenid Empire. About 550 B.C., the Persians, led by Cyrus the Great, overthrew the Medes. Cyrus was a member of a Persian *dynasty* (family of rulers) called the Achaemenid. By 539 B.C., Cyrus had con-

Alain Nogues, Sygma

Petroleum accounts for most of the total value of Iran's exports. The country's chief oil-exporting terminal is at Kharg Island, *shown here,* in the Persian Gulf.

quered Babylonia, Palestine, Syria, and all Asia Minor. Cyrus's son Cambyses added Egypt to the Achaemenid Empire in 525 B.C. In 522 B.C., Darius I became king. Under his rule, the empire prospered. Darius built roads, established shipping lines, and introduced gold and silver coins. At its peak in 500 B.C., his vast empire stretched west into what is now Libya, east to what is now Pakistan, and from the Gulf of Oman in the south to the Aral Sea in the north.

After the mid-400's B.C., the Achaemenid Empire declined under the rule of a series of weak kings. In 331 B.C., Alexander the Great of Macedonia conquered the empire. Alexander wanted to combine the Greek and Persian cultures to create a new world empire. However, he died in 323 B.C. without achieving his goal. One of his generals, Seleucus, founded a new dynasty, the Seleucid. The Seleucids governed Iran until about 250 B.C., when armies from Parthia, a kingdom located southeast of the Caspian Sea, conquered the country (see **Parthia**).

The Sassanid dynasty. In A.D. 224, the Persians, led by Ardashir, overthrew the Parthians. Ardashir founded the Sassanid dynasty, which ruled Iran for more than 400 years. During that period, Iranian art flourished. The Sassanid kings also improved the country's cities, roads, and irrigation system. But their reign was weakened by constant warfare with the Romans. Sassanid rule was ended by a new force of conquerors—Muslims from Arabia. For a more detailed history of Iran before the Arab conquest, see **Persia, Ancient**.

The rise of Islam. Arabian armies conquered Iran in the mid-600's. The Arabs gradually converted most Iranians to Islam. Arabic replaced Persian as the official language of government in Iran, but most common people continued to speak Persian. Persian was also used in literature. By the mid-800's, Iran had become a world center of art, literature, and science. But Arab control weakened during the 900's, and Iran broke into a number of small kingdoms under various Iranian rulers.

By the mid-1000's, Seljuk Turks from Turkestan had conquered most of Iran. The Seljuks and other Turkish tribes ruled until 1220. That year, the Mongols, led by Genghis Khan, swarmed over Iran. They destroyed many cities and killed thousands of people. Iranian civilization declined under Mongol rule. During the 1400's, the Mongols began fighting among themselves for power and gradually lost control of Iran.

The Safavid dynasty. In the late 1400's and early 1500's, the Safavids, a family of Persian descent, gained control over several regions in Iran. In 1501, the family's leader, Ismail, was crowned king, founding the Safavid dynasty. The greatest Safavid king was Shah Abbas, who ruled from 1588 to 1629. He stopped invasions by Ottomans from central Asia and by Uzbek tribes from Turkestan. Shah Abbas and his successors strongly supported the development of architecture and other arts. Isfahan, which became the Safavid capital in 1598, was known as one of the world's most beautiful cities. Safavid kings ruled Iran until 1722, when armies from Afghanistan invaded the country and captured Isfahan.

The rule of Nadir Shah. During the 1730's, Nadir Shah, a Turkish tribesman, drove the Afghans out of Iran and became king. He went on to conquer Afghanistan. In 1739, Nadir Shah took the city of Delhi in India. He brought back many treasures from India, including the jewel-encrusted Peacock Throne. Nadir Shah was assassinated in 1747. Various Iranian leaders then struggled for power. In the 1750's, Karim Khan, a Kurd of the Zand tribe, gained control of Iran.

The Qajar dynasty. After Karim Khan died in 1779, war broke out between the Zands and the Qajars, a Turkoman tribe from the Caspian Sea region. During this period, Iran lost Afghanistan and other areas that Nadir Shah had conquered. The Qajars finally defeated the Zands in 1794. The Qajar dynasty ruled Iran until 1925. The Qajars established their capital in Tehran, where most of their supporters lived.

In 1826, Russia invaded Iran. Russia wanted to expand its territory and gain an outlet to the Persian Gulf. It defeated Iran in 1827. In 1828, the two nations signed the Treaty of Turkomanchai. The agreement gave Russia the land north of the Aras River. In 1856, Iran tried to recapture its former territory in northwestern Afghanistan. But Britain controlled Afghanistan and declared war on Iran. In 1857, Iran and Britain signed a peace treaty, under which Iran gave up all of its territorial claims to Afghanistan.

British and Russian influence in Iran increased during the rest of the 1800's. In the early 1900's, a British corporation, the Anglo-Persian Oil Company, began to develop the oil fields of southwestern Iran.

During the late 1800's and early 1900's, Iranian intellectuals and Iranians who had come into contact with the West introduced new ideas of political freedom into the country. Many Iranians began to demand a constitutional government. In 1906, the Qajar monarch, Shah Muzaffar al-Din, was forced to give Iran its first Constitution and a parliament, the Majlis.

World War I and Reza Shah. Iran became a battleground during World War I (1914-1918), even though it remained neutral. Russian troops, defending the oil fields at Baku on the Caspian Sea, fought the Turks in northwestern Iran. A British army defended the Khuzistan oil fields against attack by Iran's Qashqai people. The Qashqai rebels were led by German agents.

In 1921, Seyyed Zia al-Din Tabatabai, an Iranian politician and journalist, and Reza Khan, a cavalry officer,

Important dates in Iran

1500's B.C. Aryans began migrating to Iran and split into two groups, the Medes and the Persians.
550 B.C. The Persian king Cyrus the Great overthrew the Medes and founded the Achaemenid (Persian) Empire.
331 B.C. Alexander the Great conquered the Achaemenid Empire.
250 B.C. Parthian armies seized control of Iran.
A.D. 224 The Persians overthrew the Parthians.
Mid-600's The Muslim Arabs conquered Iran.
1220 The Mongols invaded Iran.
1501–1722 The Safavid dynasty governed Iran.
1794 The Qajars, a Turkoman tribe, set up a new dynasty that ruled Iran until 1925.
1906 Shah Muzaffar al-Din signed Iran's first Constitution.
1925 Reza Khan became shah.
1941 Mohammad Reza Pahlavi succeeded to the throne.
1951 The Majlis nationalized the oil industry.
1979 Revolutionaries took control of Iran's government.
1980 War broke out between Iran and Iraq. A cease-fire was declared in 1988.

overthrew the Qajar government. In 1925, Reza became shah and changed his family name to Pahlavi. Reza Shah introduced many programs to modernize Iran and to free it from foreign interference.

The nationalist movement. Iran declared its neutrality soon after World War II began in 1939. But the Allies wanted to use the Trans-Iranian Railway to ship war supplies from Britain to the Soviet Union. Reza Shah refused to cooperate. British and Soviet troops invaded Iran in 1941. They forced Reza Shah to give up the throne. His son, Mohammad Reza Pahlavi, became shah. The new shah signed a treaty with Britain and the Soviet Union that allowed them to use the railway and to keep troops in Iran until the end of the war.

The presence of foreign troops in Iran during the war stirred up nationalistic feelings among many Iranians. In the Majlis, a group of nationalists led by Mohammad Mossadegh demanded an end to British control of the oil industry. In 1951, the Majlis voted to place the oil industry under government ownership and control. After the prime minister refused to carry out the law, he was dismissed and replaced by Mossadegh.

In 1953, a British boycott of Iranian oil, together with a surplus of oil on the world market, made it impossible for Iran to sell its oil abroad. Iran suffered heavy financial losses, and the shah tried to remove Mossadegh from office. Mossadegh and his followers then forced the shah to go into exile. But the shah, with the help of the U.S. Central Intelligence Agency (CIA), returned to power after a few days, and Mossadegh was arrested.

Reforms and growing unrest. During the early 1960's, the shah began a series of economic and social reforms known as the White Revolution (later called the Shah-People Revolution). His programs included a large-scale land reform program that redistributed the holdings of wealthy landlords among the peasants who worked the land. The shah also promoted education, improved social welfare services, and gave women the right to vote. At the same time, he used Iran's increasing oil revenues to develop many new industrial projects and to provide a base for future economic growth.

Politically, the shah exercised nearly absolute control over the government. His vast power aroused much opposition, especially from students and intellectuals. His critics denounced him for denying freedom of speech and other civil rights and for using a secret police force—called the SAVAK—to crush opposition to his rule. They also claimed that his policies and government corruption were ruining Iran's economy. Many conservative Muslims believed that the shah's modernization programs violated traditional Islamic teachings.

Revolution and the Islamic Republic. In the late 1970's, the various opponents of the shah united under Ayatollah Ruhollah Khomeini, a Muslim religious leader. In January 1979, the shah left Iran after mass demonstrations, strikes, and riots against his rule. The next month, the revolutionaries took control of the government.

Khomeini declared Iran an Islamic republic. He and his followers set up a new government based on the teachings of Islam. Khomeini became the *faqih,* or supreme leader, of Iran. For the first year after the revolution, a Revolutionary Council appointed by Khomeini carried out the new government's policies. Hundreds of officials of the shah's government were tried in revolutionary courts and put to death by firing squads. The Islamic government shut down newspapers and magazines, banned political parties, closed universities, and placed restrictions over the people's personal freedoms. In 1980, the Iranian people elected the first president and the first Majlis of the republic.

The new government was bitterly anti-American because the United States had supported the shah. In October 1979, President Jimmy Carter allowed the shah to enter the United States for medical treatment. On November 4, Iranian revolutionaries seized the United States Embassy in Tehran and held a group of Americans—chiefly embassy workers—as hostages. The United States and many other countries denounced this action as a violation of international law and demanded that the hostages be freed. The revolutionaries said they would release the hostages if the U.S. government returned the shah to Iran for trial. The United States re-

Sipa Press from Black Star

Ayatollah Ruhollah Khomeini, shown waving to his followers, led the 1979 revolution that overthrew Mohammad Reza Pahlavi. Khomeini declared Iran an Islamic republic.

Sipa Press

A hostage crisis developed in Iran in 1979 when anti-American Iranian revolutionaries seized the United States Embassy in Tehran. The revolutionaries took a group of Americans hostage and did not release them until January 1981. This photograph shows a bound and blindfolded hostage with some of his Iranian captors.

fused to do so. The shah moved to Panama in December 1979 and to Egypt in March 1980. He died in Egypt in July 1980. The revolutionaries freed the hostages on Jan. 20, 1981. See Carter, Jimmy (The Iranian crisis).

The war with Iraq. In 1980, Iran began fighting a war with Iraq over territorial disputes and other disagreements. Hundreds of thousands of Iranians were killed or injured, and over a million people were left homeless. Iraqi planes repeatedly bombed oil installations, industrial targets, and civilian centers in Iran. Iran and Iraq agreed to a cease-fire in August 1988. Negotiations for a peace treaty started shortly after the cease-fire began.

The death of Khomeini. Ayatollah Khomeini died in 1989. Iran's top religious leaders chose Ali Khamenei to succeed Khomeini as faqih. Khamenei had been Iran's president. Hashemi Rafsanjani was elected Iran's new president in 1989 and was reelected in 1993.

Recent developments. Iran faced serious economic and political problems in the 1990's. Its oil exports were reduced sharply, in part because of decreased production capacity. The decline in oil revenues made it difficult for Iran to pay for much-needed imports. Other serious economic problems in Iran included rising prices, mounting foreign debt, and a high unemployment rate.

Iran continued to have strained relations with the United States. During the 1990's, the United States became especially concerned about Iran's efforts to acquire nuclear technology. The United States feared that such technology might give Iran the ability to produce nuclear weapons and that such weapons might then become available to terrorists or be used against Israel. In May 1995, U.S. President Bill Clinton issued an executive order that barred all U.S. trade with Iran. The order was designed to punish Iran economically for seeking to acquire nuclear technology and for what the United States saw as Iran's support for terrorism.

Political discontent within Iran increased after the death of Khomeini in 1989. Serious conflicts and rivalries emerged among the country's leaders. A growing number of people openly blamed government leaders for the mismanagement of the economy and widespread government corruption. In 1997, Iranian voters elected Mohammad Khatami as president. A former minister of culture, Khatami is widely considered to be a moderate.

In parliamentary elections held in 2000, members of reform groups won a majority of seats in the Majlis. These groups supported a number of measures, including freedom of the press and less government influence over Iranians' personal lives. Shortly after the elections, the United States announced it was easing some of the sanctions against Iran. In 2001, Khatami was reelected president by a wide margin. Ali Banuazizi

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Questions

How did the Arab conquest influence Iran?
What does the name *Iran* mean?
Why is the Caspian Sea Coast so heavily populated?
What is a *zurkhaneh*? A *chador*? *Now Ruz*?
How did the revolution of 1979 change Iran's government?
What was the White Revolution?
How did the Islamic revolution damage Iran's economy?
What is the official language of Iran?
What is the main legislative body of the Iranian government?
What is Iran's most important mineral?

Additional resources

Mackey, Sandra. *The Iranians.* Dutton, 1996.
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Iran-contra affair is the name of a major United States foreign policy scandal in the 1980's. It involved two secret operations by the executive branch of the government. The operations were (1) the sale of military equipment to Iran, an enemy of the United States; and (2) the provision of military aid to contra rebels in Nicaragua, which Congress had banned. The two operations were connected by the use of profits from the Iranian arms sales to aid the contra rebels.

Background. In 1979, a political coalition called the Sandinistas led a revolution in Nicaragua and took control of the government. After United States President Ronald Reagan took office in 1981, he claimed the Sandinistas had set up a Communist dictatorship. He directed the Central Intelligence Agency (CIA) to begin aiding the contras, Nicaraguan rebels who were fighting to overthrow the Sandinistas. In 1983, however, Congress voted to limit the CIA support. In October 1984, Congress voted to cut off all aid to the contras.

Administration actions. The Reagan administration sought ways to continue aiding the contras after the congressional ban. At first, it secretly raised funds from several foreign countries and wealthy Americans to help finance the contra efforts.

In 1985, the administration initiated a secret "arms-for-hostages" operation designed to free seven Americans held hostage by terrorists in Lebanon. Reagan had said he would never deal with supporters of terrorists, which he considered Iran's leaders to be. But he and his advisers believed Iran could get the hostages released. Members of the administration arranged for the CIA to secretly purchase arms from the Department of Defense. Private individuals bought the arms from the CIA and sold them to Iran in return for its promises of help in the hostage release. But the sales led to the release of only three hostages, and three more Americans were taken hostage during the same period. Administration agents secretly *diverted* (transferred) profits from the arms sales to the contras.

Arthur Grace, Sygma

The Iran-contra affair led to congressional hearings in which Reagan administration aide Oliver L. North, *left*, testified. The affair involved Administration actions of selling arms to Iran and using profits to aid Nicaraguan rebels called contras.

Reagan said he could not remember whether he knew in advance about the 1985 arms shipments and that he knew nothing about the diversion of funds. Both actions had been carried out by staff of the National Security Council (NSC), a White House intelligence and policy coordinating agency. Marine Lieutenant Colonel Oliver L. North, an NSC aide, was the person most closely involved in the management of the Iran-contra operations.

Charges and court actions. Reports of the arms sales and contra aid became widely known in November 1986. Congressional hearings held in 1987 concluded the NSC staff had attempted to deceive Congress about the affair. In November 1987, a joint report by congressional committees said Reagan was accountable for the "secrecy, deception, and disdain for the law" that characterized Iran-contra. It said his administration's efforts to raise money for government operations outside of Congress violated basic constitutional rules.

In 1989, a federal court convicted North on three charges relating to the Iran-contra affair, including altering and destroying evidence. North had worked under national security advisers Robert C. McFarlane and John M. Poindexter. In 1989, McFarlane pleaded guilty of withholding information from Congress during its investigation. In 1990, Poindexter was convicted of conspiracy and of lying to and obstructing Congress.

In 1987, North and Poindexter had testified about the Iran-contra affair during the congressional hearings. They had been given *immunity* (freedom from prosecution) on matters of their testimony. In 1990 and 1991, appeals courts overturned the convictions of North and Poindexter on grounds that their 1987 testimony might have influenced the outcome of their later trials. In 1992, Caspar W. Weinberger, Reagan's secretary of defense, was charged with lying to Congress and government investigators in connection with the Iran-contra affair. But later that year, President George H. W. Bush pardoned Weinberger, McFarlane, and several other officials for any crimes they may have committed in relation to the affair. Bush was Reagan's vice president and succeeded him as president in 1989. Only one person, former CIA agent Thomas G. Clines, went to prison as a result of Iran-contra. He was sentenced to 16 months in prison for evading taxes on income from the operations. Four others pleaded guilty to lesser charges and received sentences of probation, community service, and fines.

On Jan. 18, 1994, a special prosecutor, Lawrence E. Walsh, issued the final report of the Iran-contra affair. The report said the Iran-contra operations "violated United States policy and law," and it criticized the Reagan and Bush administrations for involvement in a cover-up.

Peter Kornbluh

© Filip Horvat, Saba

Baghdad is the capital of Iraq and one of the largest cities in the Middle East. Some parts of Baghdad feature wide boulevards and modern buildings, *shown here.* Other sections of the city have narrow, dusty streets and colorful bazaars.

Iraq

Iraq, *ih RAHK* or *ih RAK,* is an Arab country at the head of the Persian Gulf in southwestern Asia. The country is bordered by Turkey, Iran, Kuwait, Saudi Arabia, Jordan, and Syria. Baghdad is Iraq's capital and largest city.

The world's first known civilization and other early cultures developed along the Tigris and Euphrates rivers in what is now Iraq. The ancient Greeks called part of Iraq and the surrounding region *Mesopotamia* (between rivers) because it lay between the Tigris and Euphrates rivers. For thousands of years, civilizations there have depended on controlling flooding from the two rivers and on using their waters for irrigation.

Iraq became part of the Arab Empire in the A.D. 600's and absorbed Arab Muslim culture. Today, about 75 percent of Iraq's people are Arabs. Iraq also has a large Kurdish population that has struggled on and off for self-government for many years.

Iraq's economy depends heavily on the export of oil. Income produced by the oil industry has improved living conditions for Iraq's people.

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In the 1980's and the early 1990's, President Saddam Hussein and other leaders of the ruling Baath Party involved Iraq in two wars that had devastating effects on the country. Iraq fought a war with Iran from 1980 to 1988, when a cease-fire was declared. In 1990, Iraq invaded and occupied neighboring Kuwait. The United Nations (UN) condemned the invasion and imposed a

Facts in brief

Capital: Baghdad.
Official language: Arabic.
Official name: Al-Jumhuriya Al-Iraqiya (Republic of Iraq).
Area: 169,235 mi² (438,317 km²). *Greatest distances*—north-south, 530 mi (853 km); east-west, 495 mi (797 km). *Coastline*—40 mi (64 km).
Elevation: *Highest*—about 11,840 ft (3,609 m) in Zagros Mountains. *Lowest*—sea level.
Population: *Estimated 2002 population*—24,451,000; density, 144 per mi² (56 per km²); distribution, 68 percent urban, 32 percent rural. *1987 census*—16,335,199.
Chief products: *Agriculture*—barley, dates, grapes, rice, tomatoes, and wheat. *Mining*—petroleum. *Manufacturing*—building materials, chemicals, flour, iron and steel, leather goods, petroleum refining, textiles.
National anthem: "Al-Salam Al-Jumhuri" ("Salute to the Republic").
Money: *Basic unit*—dinar. One thousand fils equal one dinar.

trade embargo on Iraq. A coalition of 39 nations, including the United States and Canada, opposed the invasion and sent forces to the region. In early 1991, they defeated Iraq in the Persian Gulf War.

Government

National government. Although Iraq's Constitution of 1970 states that Iraq is a republic, the country actually functions as a dictatorship. President Saddam Hussein and other leaders of the ruling Baath Party control all branches of the government. The Baath Party eliminated most of its political opponents when it took power in 1968. Since then, the government has restricted the political activity of anyone not belonging to the party or to allied parties. The government has done this partly through its secret police organization.

In September 1991, the government issued a law permitting the formation of opposition political parties. But restrictions in the law have prevented any significant challenge to the Baath Party's domination.

According to the Constitution, a president heads the Republic of Iraq and is commander of its armed forces. The president is elected to an indefinite term of office by the Revolutionary Command Council (RCC), which is made up of about 10 top officials of the Baath Party. The president chairs the RCC, and the RCC determines government policy. A Council of Ministers appointed by the president carries out government operations.

Iraq's legislature, the National Assembly, has 250 members. Adults over the age of 18 elect Assembly members to four-year terms. But the Baath Party controls elections through a government-appointed commission that determines who may run for the Assembly. In theory, the Assembly is authorized to either approve or reject RCC proposals. But in practice, the Assembly always approves such proposals.

Local government. Iraq has 18 provinces. The president appoints a governor for each province and a mayor for each Iraqi city. Three Kurdish provinces had limited *autonomy* (self-rule) as the Kurdish Autonomous Region from 1974 to 1991, when local government was suspended during the Persian Gulf War. As a result of a Kurdish uprising after the war, the Iraqi government has refused to reconsider local autonomy for the Kurds. In May 1992, however, the Kurds held elections under UN protection.

Courts. Iraq's judicial system consists of civil and religious courts and special security courts. Civil courts handle cases of civil, commercial, and criminal law. The religious courts deal primarily with family issues, such as divorce and inheritance. Special security courts prosecute individuals accused of crimes against the state. The president appoints members of the judiciary.

Armed forces. Iraq's armed forces consist of a large army and a smaller air force and navy. Before the Persian Gulf War, the Iraqi army was one of the largest in the world, with an estimated 955,000 troops. Today, the Iraqi army has an estimated 350,000 troops. All Iraqi men aged 18 and over must serve in the military for a period lasting from 21 to 24 months.

People

Iraq has a high population growth rate, and so its population is expanding rapidly. About three-fourths of Iraq's people live in a fertile plain that extends from Baghdad south along the Tigris and Euphrates rivers. This area has many of the largest cities and towns of Iraq.

Arabs make up about 75 percent of Iraq's population. Approximately 20 percent of the country's people belong to Iraq's largest ethnic minority, the Kurds. Other ethnic groups in Iraq include Armenians, Assyrians, Turkomans, and Yazidis.

Language. Iraq's official language is Arabic, which is spoken throughout the country. Kurdish, the language of the Kurds, is official in Kurdish areas.

City life. Most of Iraq's people live in cities. The number of people living in urban areas has increased dramatically since the 1940's as a result of migration from rural areas. Many people have moved to the cities in search of work. Others fled rural villages and southern Iraqi cities that were heavily damaged in the 1980's during Iraq's war with Iran. Overflowing urban populations have resulted in severe unemployment and housing shortages in some cities.

Wealthy city dwellers work in business and government. Many of them live in the suburbs. People at middle-income levels earn a living as office workers, craftworkers, and owners of small businesses. Many of them reside in apartment buildings in the cities. A large number of laborers and factory and oil workers commute to jobs in Iraq's cities from homes in nearby villages.

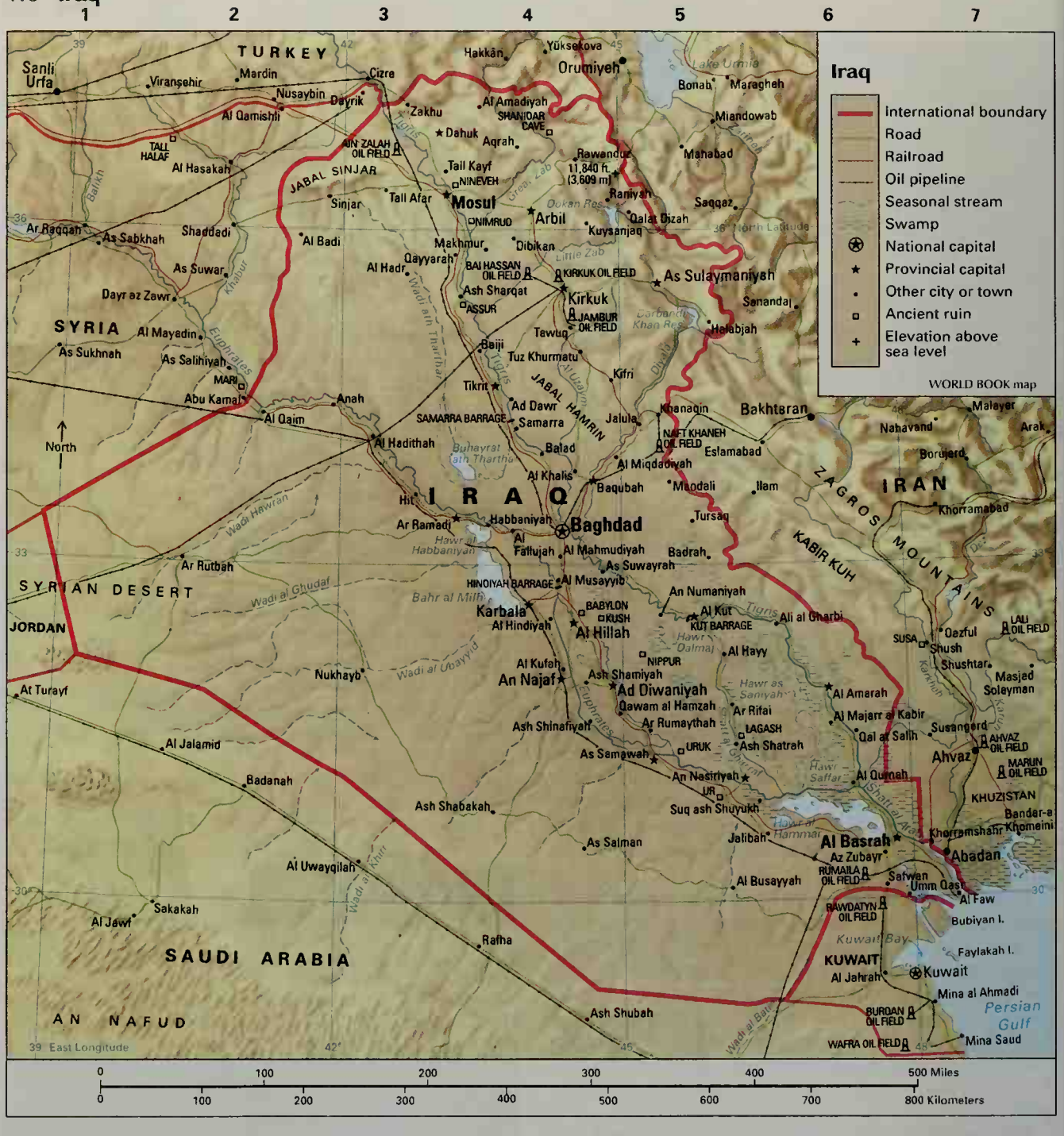
Clothing styles vary in Iraq's cities. Middle-class and

Iraq's flag was adopted in 1991. The Arabic inscription on the white stripe means "God is great."

The coat of arms, adopted in 1965, has an eagle resembling a sculpture in the castle of Saladin, an Arab warrior.

WORLD BOOK map

Iraq lies in southwestern Asia. It is bordered by Turkey, Iran, the Persian Gulf, Kuwait, Saudi Arabia, Jordan, and Syria.



Iraq map index

Cities and towns

Ahu al Khasib*	12,681	F	7
Ahu Ghurayb	10,554	D	4
Ad Dawr		C	4
Ad Diwaniyah	239,000	E	5
Al Amarah	164,000	E	6
Al Badi		B	3
Al Basrah	678,000	F	6
Al Busayyah		F	6
Al Fallujah	174,000	F	7
Al Faw	27,000	F	7
Al Hadithah	6,849	C	3
Al Hadr		B	3
Al Harithah	9,267	F	6
Al Hayy	41,000	E	5
Al Hillah	279,000	D	4
Al Hindiyah	41,000	D	4
Al Khalis	35,000	C	4
Al Kufah	30,531	E	4
Al Kut	141,000	D	5
Al Mahmudiyah	10,656	D	4
Al Majarr al Kabir	8,971	E	6
Al Miqdadiyah	31,000	C	5
Al Musayyib	39,000	D	4
Al Qaim		C	2
Al Qasim	7,436	E	5
Al Qurnah	4,988	F	6
An Najaf	423,000	E	4
An Nasiriyah	191,000	F	5
An Numaniyah	29,000	D	5
Anah	5,620	C	3
Aqrah	8,671	A	4
Arbil	479,000	B	4
Ar Ramadi	174,000	D	3
Ar Rifai	7,551	E	5
Ar Rumaythah	10,433	E	5
Ar Rutbah		D	2
As Salman		F	5
As Samawah	77,000	E	5
As Sulaymaniyah	394,000	B	5
Ash Shahakah		F	4
Ash Shamiyah	32,000	E	6
Ash Sharqat		B	4
Ash Shatrah	46,000	E	6
Ash Shinafiyah	6,476	E	4
Az Zubayr	70,000	D	4
Badrah		D	5
Baghdad	5,908,000	D	4
Baiji	7,042	C	4
Balad	34,000	C	4
Baquhah	165,000	D	5
Dahuk	42,000	A	3
Habbaniyah	48,000	D	4
Halabjah	11,250	B	5
Jalibah		F	5
Jalula	31,000	C	5
Karbala	237,000	D	4
Khanaqin	58,000	C	5
Kifri	8,267	C	5
Kirkuk	404,000	B	4
Kuysanjaq	10,379	B	4
Mandali	10,951	D	5
Mosul	748,000	B	4
Nukhayb		E	3
Qawam al Hamzah	10,817	E	5
Qayyarah		B	3
Rawanduz	5,411	A	4
Safwan		F	7
Samarra	78,000	C	4
Shatt al Arab*	13,558	F	6
Sinjar	7,984	B	3
Suq ash Shuyukh	41,000	F	5
Tall Afar	104,000	B	3
Tall Kayf	7,381	A	4
Tawuq		B	4
Tikrit	9,863	C	4
Tursaq		D	5
Tuz Khurmatu	35,000	C	4
Umm Qasr		F	7
Zakhu	36,000	A	3

Physical features

Buhayrat ath Tharthar (lake)	C	4
Euphrates River	E	4
Great Zab River	B	4
Hawr al Habbaniyah (lake)	D	4
Hawr al Hammar (lake)	F	6
Hawr as Saniyah (lake)	E	6
Hindiyah Barrage	D	4
Kut Barrage	E	5
Little Zab River	B	4
Nineveh (ruins)	B	4
Persian Gulf	G	7
Samarra Barrage	C	3
Shatt al Arab River	F	6
Syrian Desert	D	1
Tigris River	C	4
Wadi al Ubayyid (river)	E	3

*Does not appear on map; key shows general location.

Sources: 1991 estimates from the Center for International Research of the Bureau of the Census for largest cities; latest available census (1965) for other places.

J. Pavlovsky, Sygma

Shops in Baghdad offered a wide variety of items before a 1990 United Nations embargo led to shortages.

J. Pavlovsky, Sygma

Craftsmen work on brass pots in Baghdad. Iraqi metalworkers produce beautiful trays, pitchers, and other objects.

wealthy people generally wear Western-style clothing. Most laborers prefer traditional clothes. For men, these garments include long cotton gowns and jackets. Traditional dress for women consists of a long, concealing gown and a scarf that covers much of the head.

Rural life. Many of the people who live in rural areas of Iraq are villagers who farm for a living. Most farmers lease land from the government through companies that are largely government-owned. Herders form a small part of rural society. Bedouin *nomads* (wanderers) herd camels, goats, and sheep in western Iraq. Some Kurds graze livestock in northern Iraq.

Buildings in the rural areas of southern and central Iraq are made of dried mud and brick. In the north, villagers build stone houses.

Clothing in the countryside is traditional. Arab men wear gowns and checkered headdresses. Women dress in long black robes, and some veil their faces. Kurdish men wear shirts and baggy trousers with sashes. Kurdish women wear trousers but cover them with a dress.

Food and drink. Iraqis eat a varied diet that includes vegetables, rice, flat bread, meat, fish, and dates. Bread and rice are the main foods at many meals. Grilled lamb, chicken, and fish are popular. *Sanbusak,* a traditional Iraqi dish, consists of moon-shaped dough stuffed with cheese or meat. Popular beverages in Iraq include tea, coffee, and fruit juices.

Recreation. Iraqis enjoy a variety of sports and games, including soccer, horse racing, backgammon, and chess. Weddings and other family events are occasions for traditional folk dances and songs.

Religion. About 95 percent of Iraq's people are Muslims. More than half of the country's Muslims are Shiites (members of the Shiah branch of Islam). The other Muslims belong to the Sunni division. Most Arabs living southeast of Baghdad are Shiites. Central and southwestern Iraq is a mixture of Sunni and Shiite Arab populations. The Kurds are Sunnites. Christians and other groups make up about 5 percent of the Iraqi population. Most high-ranking members of Iraq's ruling Baath Party are Arab Sunni Muslims. Many Shiites resent the Sunni monopoly on governmental power.

Education. Iraqi law requires all children from ages 6 through 12 to attend school. Some children continue their education in vocational or secondary schools. Iraq has universities in Al Basrah, Arbil, Baghdad, Mosul, and Tikrit. A higher percentage of men than women attend colleges and universities in Iraq.

More than half of Iraq's adult population can read and write. For the country's literacy rate, see **Literacy** (table: Literacy rates for selected countries).

The land

Iraq has four major land regions: (1) the northern plain, (2) the southern plain, (3) the mountains, and (4) the desert.

The northern plain, a region of dry, rolling land, lies between the Tigris and Euphrates rivers north of the city of Samarra. The highest hills in the area rise about 1,000 feet (300 meters) above sea level. There are a small number of farming villages in the northern plain.

The southern plain begins near Samarra and extends southeast to the Persian Gulf. It includes the fertile delta between the Tigris and Euphrates rivers, where a large number of Iraq's people live. The Tigris and Euphrates meet at the town of Al Qurnah and form the Shatt al Arab river, which empties into the gulf. Some of Iraq's major oil fields are located between the Shatt al Arab and the border with Kuwait.

Complex dam and irrigation systems control the flow of water in the southern plain. This control has resulted in increased agricultural productivity and allowed for more permanent human settlement, especially north of Al Kut. Much of the region south of Al Kut is swampland, due to frequent flooding and poor drainage. In 1993, the country began a program to dry up much of the swampland.

The mountains of northeast Iraq are part of a range that is called the Zagros in Iran and the Taurus in Turkey. The mountains rise to more than 10,000 feet (3,000 meters) near Iraq's borders with Iran and Turkey. Kurds live in the region's foothills and valleys. Valuable oil fields lie near the cities of Mosul and Kirkuk.

The desert covers southwestern and western Iraq.

Superstock

Dry grazing land covers much of the northern plain of Iraq. The northern plain lies between the Tigris and Euphrates rivers north of the city of Samarra.

Most of this region of limestone hills and sand dunes is part of the Syrian Desert, which stretches into Syria, Jordan, and Saudi Arabia. Scattered throughout the desert are *wadis*—valleys that are dry most of the year but become rivers after a rain.

Climate

Iraq's climate ranges from moderate in the north to semitropical in the east and southeast. The west and southwest have a desert climate—warm or hot days and much cooler nights. Summer high temperatures average more than 100 °F (38 °C) throughout much of Iraq. Winter low temperatures may drop to around 35 °F (2 °C) in the desert and in the north.

In general, little rain falls in Iraq. Average annual precipitation ranges from 5 inches (13 centimeters) of rain in the desert to 15 inches (38 centimeters) of rain and snow in the northern mountains. Most of the precipitation falls between November and April.

Economy

The export of oil has played a vital role in Iraq's economy since the 1950's. However, Iraq has tried to become less dependent on oil exports by expanding the rest of its industrial sector. During the 1970's, Iraq's economy prospered. But both the war with Iran and the Persian Gulf War greatly damaged the economy. Trade routes were disrupted, ports were closed, and factories were destroyed. In addition, the UN trade embargo imposed in August 1990 halted all oil exports from Iraq. The embargo was partially lifted in 1996.

Industry, which includes mining, manufacturing, and construction, accounts for 38 percent of Iraq's gross domestic product (GDP). The GDP is the total value of all goods and services produced within a country in a year. Mining, manufacturing, and construction employ 33 percent of Iraq's workers.

Oil is the chief mineral resource of Iraq. Iraq was once the second-largest producer of oil in the Middle East. In the early 1980's, the oil industry accounted for about 60 percent of the country's GDP. But war damaged many of the country's oil reservoirs, pipelines, and refineries and interfered with the oil trade. Iraq's major oil fields are located in southern Iraq near the Kuwait border, and west of the city of Kirkuk in the north. Other natural resources mined in Iraq include phosphates, sulfur, and natural gas.

Until Iraq's refineries were damaged in the Persian Gulf War, the country's largest manufacturing industry was oil refining and petrochemical production. Several of Iraq's chemical and oil plants are located near the cities of Al Basrah, Baiji, and Kirkuk. Other factories in Iraq process farm products or make such goods as cloth, soap, beverages, cement, iron, and steel.

Service industries account for 46 percent of Iraq's GDP. About 55 percent of the country's workers have jobs in the service sector. The government employs about 25 percent of the work force. Other major service industries in Iraq include banking and real estate.

Agriculture. Iraq was importing about 70 percent of its food before the 1990 UN trade embargo. Agriculture accounts for 16 percent of the GDP and employs about 12 percent of Iraq's work force. The government has invested heavily in agriculture. But poor organization and a lack of labor and private investment have hampered growth. Major crops harvested in Iraq include barley, dates, grapes, rice, tomatoes, and wheat. Many farmers lease their land from the government.

Energy sources. Oil and natural gas are Iraq's main energy sources. Until the 1991 Persian Gulf War, electricity was available throughout most of the country.

International trade. Oil accounts for most of Iraq's exports. The UN trade embargo, which began in 1990, halted all oil exports from Iraq. But the embargo was eased in 1996 when a UN "oil-for-food" program began. Under this program, Iraq can export oil in exchange for food, medical supplies, and other non-military goods. Iraq also exports oil illegally to nearby countries.

Transportation and communication. A government-owned airline links Baghdad with other major cities in Iraq and the Middle East and in Europe. Roads and railways connect Iraq's largest cities to one another. The shipping facilities at Al Basrah, once a major port, were damaged in Iraq's war with Iran and in the Persian Gulf War. Since then, use of the port has been limited. Many Iraqis rely on public transportation because they cannot afford automobiles. Over shorter distances in the cities, many people use bicycles. In the countryside,

people often use buses, donkeys, and camels for transportation.

Six daily newspapers—four in Arabic, one in Kurdish, and one in English—are published in Iraq. About 1 out of every 15 Iraqis owns a television set. Many more people have radios. The government controls all radio and TV broadcasting that originates in Iraq, but Iraqis can pick up radio broadcasts from other countries.

History

Early days. The world's first known civilization developed in Sumer, now southeastern Iraq, about 3500 B.C. Sumer was part of Mesopotamia, an area that included most of present-day Iraq and parts of Syria and Turkey. Other ancient civilizations, including Assyria and Babylonia, flourished along the Tigris and Euphrates rivers between about 3500 and 539 B.C. See **Assyria; Babylonia; Mesopotamia; Sumer.**

In 539 B.C., the Persians conquered Mesopotamia. Greek and Macedonian armies under Alexander the Great took the area from the Persians in 331 B.C. Greek rule continued until the Parthians, from the Caspian Sea area, established control by 126 B.C. Except for brief periods of Roman rule, the Parthians controlled Mesopotamia until about A.D. 226. That year, the Persian Sassanid *dynasty* (family of rulers) seized Mesopotamia. The Sassanids ruled the region for about 400 years.

Arab rule. The birth of Islam in the A.D. 600's inspired Arab Muslims to conquer the Sassanids in 637. The Arabs brought the Arabic language and the new Islamic religion to Mesopotamia. The Abbasid dynasty came to power in 750, and soon founded Baghdad as the capital of the Arab Empire. Under the Abbasids, Arab civilization reached great heights. By 800, Baghdad had grown into a city of nearly a million people and was a world center of trade and culture.

In 1258, Mongols from central Asia invaded Mesopotamia and destroyed the Arab Empire. The Mongols neglected Mesopotamia, and the region deteriorated culturally and economically under their rule.

Ottoman control. The Ottoman Empire, which was based in what is now Turkey, began to establish control over Mesopotamia in the early 1500's. The Ottomans battled with the Persians and local Arab leaders to maintain control over the region.

During the 1700's and 1800's, the Ottoman Empire declined in power and size in the face of new, strong nations that developed in Europe. Britain became involved in the Persian Gulf in the 1800's to protect its trade routes with India, which was then under British rule. By World War I (1914-1918), Britain had become interested in Mesopotamia's oil resources.

British rule. British troops took Mesopotamia from the Ottoman Empire during World War I. In 1920, the League of Nations, a forerunner to the United Nations, gave Britain a *mandate* (order to rule) over the area. The British set up a new government in Mesopotamia in 1921. They renamed the country Iraq and chose an Arab prince as King Faisal I.

During the 1920's, British advisers retained positions in the Iraqi government, and the British controlled Iraq's army, foreign policy, finances, and oil resources. Some Iraqis opposed British involvement, and a movement for independence developed.

Independence. Under pressure from Iraq's independence movement, Britain signed a treaty with Iraq in 1930. In the treaty, Britain promised military protection and eventual independence for Iraq. In return, Iraq promised Britain continued use of British air bases in Iraq. It also agreed to use foreign advisers from Britain only. The British mandate over Iraq ended in 1932, and Iraq became an independent nation.

In the 1930's, Iraq's politicians disagreed over the alliance with Britain. King Faisal worked to balance the interests of Iraq's political factions and to unify the country's various ethnic and religious groups. Faisal died in 1933. His son Ghazi became king. Ghazi was a weak ruler, and tribal and ethnic rebellions broke out. In 1936, anti-British groups in the army took control of the government, though Ghazi officially was still king. Ghazi died in an automobile accident in 1939. His 3-year-old son, Faisal II, became king, but the boy's uncle, Prince Abdul Ilah, ruled for him.

In 1940 and 1941, during World War II, Iraqi government leaders and army officers sought an alliance with the Axis powers—Germany, Italy, and Japan—in an attempt to end British influence in Iraq. Britain attempted to use Iraq as a military base under the provisions of the 1930 treaty, and an armed conflict broke out. The British defeated the Iraqi army in 1941, and the pro-Axis leaders left the country.

Iraq declared war on the Axis in 1943. Inflation and supply shortages brought on by World War II transformed Iraq's society and economy. A wide economic gap developed between the rich and poor. Many blamed the government for their economic situation.

Iraq helped found the Arab League, an association of Arab nations, in 1945. In 1948, Iraq joined other members of the league in a war against the newly created nation of Israel. The defeat of the Arabs touched off demonstrations in Iraq and other Arab countries.

The 1950's. In 1950 and 1952, the government of Iraq signed new agreements with foreign oil companies. The 1952 agreement gave Iraq 50 percent of the profits from oil drilled there. As a result of these agreements, Iraq's oil revenues rose dramatically. The government used some of this money to build hospitals, irrigation projects, roads, and schools. But the increased amount of money coming into Iraq also caused serious inflation.

Faisal II took full power in 1953 at the age of 18. During the 1950's, opposition to the monarchy grew steadily. Many Iraqis wanted a voice in government, and others felt that they had not benefited enough from the country's oil profits.

In addition, a large number of Iraqis opposed the government's ties to the West. In particular, they objected to the Baghdad Pact—a British-supported mutual defense agreement Iraq signed with Iran, Pakistan, and Turkey in 1955. Many Iraqis also felt that the ties with the West went against the political movement called *Pan-Arabism.* Advocates of Pan-Arabism believed that Arab countries should strive for political unity and be free of outside influence. In 1958, army officers overthrew the government and declared Iraq a republic. The rebels killed King Faisal and Prince Abdul Ilah.

The republic. The army officers set up a three-man Sovereignty Council consisting of a Shiite Arab, a Kurd, and a Sunni Arab. The council issued a temporary con-

stitution giving a cabinet the power to rule by decree with the council's approval. General Abdul Karim Kassem (also spelled Qasim), who led the revolution, became Iraq's premier. He reversed Iraq's pro-West policy and accepted both economic and military aid from Communist countries. Kassem set up land reform programs aimed at narrowing the gap between rich and poor. He also worked to develop industry in Iraq.

In 1961, Kurdish leaders asked Kassem to give the Kurds complete autonomy within Iraq and a share of the revenues from oil fields in northern Iraq. Kassem rejected the plan. In response, the Kurds revolted. A cease-fire was finally declared in 1964.

In 1963, army officers and members of the Baath Party assassinated Kassem. The Baath Party took control of the country and named Abdul Salam Arif president and Ahmed Hasan al-Bakr prime minister. Both were army officers. Later that year, Arif used the military to take over the government. Arif died in 1966, and his brother, Abdul Rahman Arif, became president. The Arifs followed socialist economic policies.

Al-Bakr overthrew Arif in 1968 and reestablished Baath control. The Baath Party quickly began to dominate all aspects of Iraqi politics. Party leaders wrote a new constitution in 1970 that institutionalized the party's control of the government. Al-Bakr supported further socialist economic reform and stronger ties with the Soviet Union. During al-Bakr's presidency, Saddam Hussein, who held important party and government posts, gained influence within the government.

In 1973, the Iraqi government completed a take-over of foreign oil companies in the country. After oil prices rose sharply later that year, Iraq made huge profits.

In 1970, al-Bakr signed an agreement with the Kurds ending eight years of on-and-off fighting. In the agreement, the government promised that beginning in 1974 the Kurds would have self-rule and several positions in the government. New fighting erupted in 1974, after the Kurds objected to revisions in the agreement. The revised agreement established limited autonomy for the Kurds in the Kurdish Autonomous Region in northern Iraq. Government forces had largely defeated the Kurds by March 1975, when a cease-fire was declared. But fighting between Kurds and government forces has continued since then. Al-Bakr resigned the presidency in 1979. Saddam Hussein succeeded him as president.

War with Iran. In September 1980, Iraq invaded Iran, and war broke out between the two countries. The war resulted in part from boundary disputes, from Iran's support for the rebellious Kurds, and from the efforts of Shiite leaders in Iran to incite rebellion in Iraq's Shiite population. In addition, Iraqi leaders believed Iran had become somewhat unstable as a result of its 1979 revolution. They felt Iran's weakened position offered Iraq an opportunity to increase its power in the region.

The war lasted eight years. An estimated 150,000 Iraqi soldiers died, and Iranian air attacks on major cities wounded and killed many of Iraq's civilians. The war also severely damaged Iraq's economy. Bombs damaged oil facilities in southern Iraq, and trade through the Persian Gulf was disrupted. Iraq and Iran finally agreed on a cease-fire in August 1988.

During the war with Iran, Iraq's Kurds supported Iran against the Iraqi government. In 1987 and 1988, the Iraqi government lashed out against the Kurds. The army released poison gas in Kurdish villages, killing thousands of people. There also were reports that the army destroyed several Kurdish towns and that the inhabitants fled to Turkey and Iran.

The Persian Gulf War. In August 1990, Iraqi forces invaded and occupied Kuwait. Before the invasion, Hussein had accused Kuwait of violating oil production limits set by the Organization of Petroleum Exporting Countries (OPEC), thus lowering the worldwide price of oil. In addition, Iraq and Kuwait had disagreed over territory and over Iraq's multibillion-dollar debt to Kuwait. The UN called for Iraq to withdraw from Kuwait and passed a resolution stating that all nations should stop trading with Iraq, except for food and medical supplies under certain circumstances. A coalition of 39 countries, including the United States and Canada, opposed the invasion and sent armed forces to the Persian Gulf region.

In November 1990, the UN Security Council approved the use of force to remove Iraqi troops from Kuwait if they did not leave by Jan. 15, 1991. Iraq refused to withdraw, and war broke out between the allied forces and Iraq early on January 17 Baghdad time (January 16 U.S. time). The United States and its allies bombed Iraqi military targets in Iraq and Kuwait. Iraq launched missiles against Saudi Arabia and Israel. On February 24 (February 23 in the United States), allied land forces began moving into Iraq and Kuwait. They defeated the Iraqi army after 100 hours of fighting. On February 27 U.S. time (February 28 in the war area), U.S. President George H. W. Bush declared a halt to all allied military operations.

The Persian Gulf War had a devastating effect on Iraq. Estimates of Iraqi soldiers killed in the war range from about 1,500 to as many as 100,000. A great number of civilians also died. Allied air raids destroyed roads, bridges, factories, and oil industry facilities and dis-

Important dates in Iraq

3500 B.C. The world's first known civilization developed in Mesopotamia, now Iraq.

539 B.C. The Persians conquered Mesopotamia.

331 B.C. Alexander the Great seized Mesopotamia.

A.D. 227 The Sassanid dynasty of Persia conquered Mesopotamia.

637 Arab Muslims overthrew the Sassanids.

1258 The Mongols invaded Mesopotamia.

1500's The Ottoman Empire began to establish control over Mesopotamia.

1920 The League of Nations gave Britain a *mandate* (order to rule) over Mesopotamia.

1932 The British mandate ended, and Iraq became independent.

1958 Army officers overthrew the Iraqi government and declared the country a republic.

1968 The Baath Party took control of Iraq's government.

1973 The Iraqi government completed its take-over of foreign oil companies in Iraq.

1980 Iraq declared war on Iran.

1988 Iraq and Iran agreed to a cease-fire.

1990 Iraq invaded Kuwait.

1991 A coalition of 39 nations, including the United States and Canada, defeated Iraq in the Persian Gulf War.

Oliver Rebbot, Woodfin Camp, Inc.

Iraqi soldiers drive past government officials, including President Saddam Hussein, *arm upraised.* Before the 1991 Persian Gulf War, Iraq had the fourth largest army in the world.

rupted electric, telephone, and water service. Diseases spread through contaminated drinking water because water purification and sewage treatment facilities could not operate without electric power. Also, the trade embargo caused serious economic problems.

Recent developments. In March 1991, Kurdish and Shiite uprisings broke out. By April, Iraqi troops put down most of the rebellions. However, some fighting continued. Refugees flooded into Iran and Turkey. Allied forces transported supplies to the refugees and set up a safety zone in northern Iraq to protect the Kurds.

Iraq accepted the terms of a formal cease-fire agreement on April 6. On April 11, the UN Security Council officially declared an end to the war. In the cease-fire agreement, Iraq promised to pay Kuwait for war damages. Iraq also agreed to the destruction of all its biological and chemical weapons, its facilities for producing such weapons, and any facilities or materials it might have for producing nuclear weapons. After the formal cease-fire, the UN continued the embargo to pressure Iraq to carry out its agreements.

Iraq had also been staging air attacks against Shiites in southern Iraq who continued to oppose the Iraqi government. In August 1992, to protect the Shiites, the allies imposed a ban on Iraqi military and civilian aircraft over the region. The safety zone in the Kurdish region also included a flight ban. The areas where flights were banned came to be called "no-fly" zones.

The no-fly zone in southern Iraq did little to protect the Shiites living there. The Iraqi government sent troops and tanks against the Shiites, and dozens of villages were destroyed. In addition, in 1993, the government began to drain the swamplands where the Shiites lived. As a result, many Shiites who grew rice in these lands were deprived of a source of food. Thousands of Shiites fled to neighboring Iran.

In November 1994, Iraq formally recognized the independence of Kuwait, as well as the current boundaries of Kuwait. Also in 1994, fighting broke out between rival groups of Kurds in the safety zone in northern Iraq. In August 1996, the Iraqi government sent troops and tanks into the zone in support of one of the Kurdish groups. The United States opposed this action, and in September, launched missiles against military targets in southern Iraq. At the same time, the United States expanded the no-fly zone in southern Iraq.

In December 1996, the UN began an "oil-for-food" program that partially lifted the embargo on Iraq. Under this program, Iraq was allowed to export oil under strict UN supervision. Most money from the oil sales was to be used to buy food and medicine for the civilian population.

Iraq still has not fulfilled the terms of the 1991 cease-fire agreement. On a number of occasions, the Iraqis have failed to cooperate with UN teams sent to Iraq to inspect suspected weapons sites. In December 1998, the United States and the United Kingdom launched a series of air strikes against Iraq. U.S. and British officials said the attacks were aimed at limiting Iraq's ability to produce weapons of mass destruction—that is, biological, chemical, and nuclear weapons. Since then, U.S. and British planes have attacked targets in northern and southern Iraq many times to enforce the no-fly zones and to disable Iraq's defense systems. Iraq has refused to allow UN weapons inspectors into the country since 1998. Michel Le Gall

Related articles in *World Book* include:

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Organization of the Petroleum Exporting Countries
Persian Gulf War
Petroleum
Saudi Arabia
Syrian Desert
Tigris River
United Nations (The Persian Gulf War)

Outline

I. Government
- A. National government
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II. People
- A. Language
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III. The land
- A. The northern plain
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IV. Climate

V. Economy
- A. Industry
- B. Service industries
- C. Agriculture
- D. Energy sources
- E. International trade
- F. Transportation and communication

VI. History

Questions

Who serves as the head of Iraq's armed forces?
Where do most of Iraq's people live?
What is Iraq's most important mineral?
What are the country's chief agricultural products?
Which ancient civilization developed in what is now Iraq?
What effect did Mongolian rule have on Mesopotamia?
Why have many Iraqis moved to urban areas?
How has Iraq used its oil income?
How did the Persian Gulf War affect Iraq's economy?
What is Iraq's most fertile region?

Additional resources

Foster, Leila M. *Iraq.* Children's Pr., 1998. Younger readers.
Tripp, Charles. *A History of Iraq.* Cambridge, 2000.
Yetiv, Steven A. *The Persian Gulf Crisis.* Greenwood, 1997.

Tony Stone Images

The Emerald Isle, as Ireland is often called, is famous for the beauty of its lush, green landscape. The country's many mountains create scenic views, such as the one through Moll's Gap, *shown here.* Moll's Gap is a pass in the Mountains of Kerry, in southwestern Ireland.

Ireland

Ireland is a small, independent country located in northwestern Europe. The country's official name is Ireland. However, the country is generally called the Republic of Ireland to distinguish it from Northern Ireland. Dublin is the capital and largest city of Ireland. The country occupies about five-sixths of the island of Ireland. The remaining one-sixth of the island is occupied by Northern Ireland, which is part of the United Kingdom of Great Britain and Northern Ireland (see **Northern Ireland**).

In Gaelic, the ancient language of Ireland, the country is called Éire (pronounced *AIR uh*). Gaelic and English are the two official languages. Ireland also has long been known by the poetic name *Erin. Erin go bragh* is a well-known phrase in Gaelic that means *Ireland forever.*

Ireland is also known as the *Emerald Isle* because of its beautiful green countryside. Rolling farmlands, which are mainly pasture, cover much of the central part of the country, and mountains rise near the coasts.

Ireland is divided into 26 counties, some of which are known for special features. For example, County Kerry is famous for its mountains and the scenic Lakes of Killarney. County Waterford is known for its delicate cut glass, and County Donegal is famous for its tweed cloth.

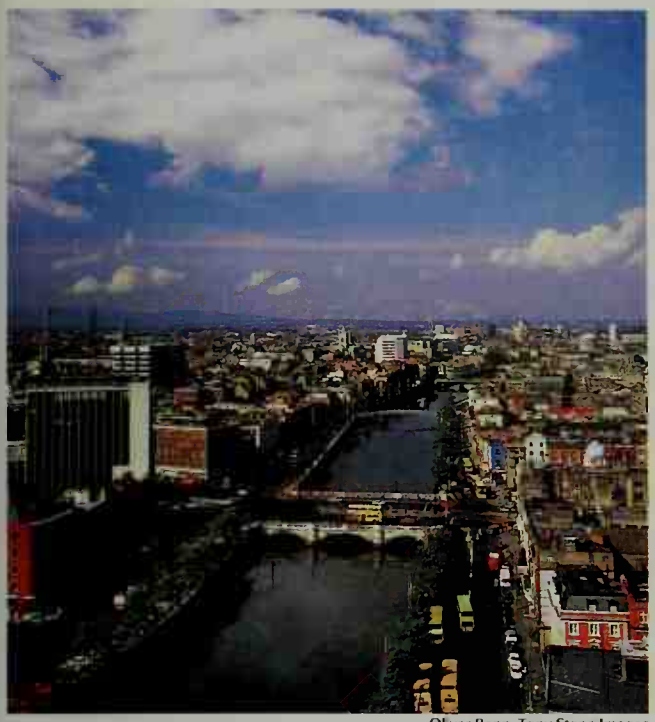
Many people consider the Irish to be exceptionally warm-hearted and friendly. The Irish also have a reputation for hospitality, close family ties, and skill as writers and storytellers.

The Irish have a long history that includes many hardships and struggles. In the 1840's, a potato blight and the starvation and disease that followed caused the deaths of about a million people, and at least 1 $\frac{1}{4}$ million more left their homeland. After this famine, a shortage of jobs and other problems caused emigration to continue. Emigration remained a problem until the mid-1900's. But at that time, the population began increasing slowly. By the end of the 1900's, a growing economy encouraged people to stay, and many who had left returned.

The contributors of this article are Desmond A. Gillmor, Associate Professor of Gengraphy at Trinity College, University of Dublin, and Brendan O'Leary, Professor of Political Science at the London School of Economics.

Facts in brief

Capital: Dublin.
Official languages: English and Gaelic.
Area: 27,137 mi² (70,284 km²). *Greatest distances*—north-south, 289 mi (465 km); east-west, 177 mi (285 km). *Coastline*—1,738 mi (2,797 km).
Elevation: *Highest*—Carrauntoohill, 3,414 ft (1,041 m) above sea level. *Lowest*—sea level along the coast.
Population: *Estimated 2002 population*—3,811,000; density, 140 per mi² (54 per km²); distribution, 58 percent urban, 42 percent rural. *1996 census*—3,626,087.
Chief products: *Agriculture*—barley, beef and dairy cattle, hogs, horses, potatoes, poultry, sheep, sugar beets, wheat. *Manufacturing*—alcoholic beverages, chemicals, clothing, computers, machinery, medicines, metal products, paper, printed materials, processed foods, textiles.
National anthem: "The Soldier's Song."
Money: *Basic unit*—euro. One hundred cents equal one euro. The Irish pound was taken out of circulation in 2002.



Oliver Benn, Tony Stone Images

Dublin is Ireland's capital and largest city. The River Liffey flows through the city center. There, it is crossed by O'Connell Bridge, named for the Irish patriot Daniel O'Connell.

Ireland was under British rule for hundreds of years. It became independent from the United Kingdom in 1921.

Government

Ireland is a republic with a president, a prime minister, and a parliament. The government is based on the Irish Constitution of 1937.

The president, Ireland's official head of state, is elected by the people to a seven-year term and may serve only two terms. Presidential duties include calling Parliament into session, appointing the prime minister and other officials, and signing laws passed by Parliament. The president may also send bills proposed by Parliament to Ireland's Supreme Court to determine their constitutionality. But the president's powers are limited. For example, the prime minister must be nominated by the Parliament's House of Representatives.

The prime minister and Cabinet. The prime minister leads the government. The prime minister is the leader of the party with a majority in the House of Representatives. If no party holds a majority, the prime minister is the leader of the ruling coalition of parties. The prime minister is called the *taoiseach* (pronounced *TEE shawk*) in Gaelic. The prime minister recommends Parliament members to head government departments to the president. These leaders form the Cabinet.

Parliament, called the *Oireachtas (EHR uhk thus)* in Gaelic, consists of the House of Representatives *(Dáil Éireann,* pronounced *DAWL AIR uhn)* and the Senate *(Seanad Éireann,* pronounced *SHAN uhd AIR uhn).* The House of Representatives makes Ireland's laws. It has 166 members, who are elected by the people to serve up to five years. The Senate serves mainly as an advisory body to the prime minister and the House of Representatives. None of its 60 members, who also serve terms of up to five years, are directly elected. The prime minister appoints 11 members of the Senate, and graduates of the National University of Ireland and of the University of Dublin choose 6 members. The rest are elected from panels of candidates representing five fields—(1) agriculture, (2) commerce and industry, (3) culture and education, (4) labor, and (5) public administration. They are elected by a body of about 1,000 members, drawn from the House of Representatives and local governments.

Politics. Ireland has six major political parties—Fianna Fáil *(FEE uh nuh FAWL),* also called the Republican Party; Fine Gael *(FIHN uh GAYL);* the Labour Party; Sinn Féin *(shihn fayn);* the Progressive Democrats; and the Green Party. People at least 18 years old who have lived in Ireland for five years may vote.

Courts. The Supreme Court is Ireland's highest court. The second highest is the High Court. Both courts handle appeals from lower courts and can declare laws unconstitutional. Lower courts include the Court of Criminal Appeal, 8 circuit courts, and 24 district courts. All judges are appointed by the president and serve for life.

Local government. Ireland is divided into 26 counties. For administrative purposes, Tipperary is split in two, making 27 counties. Ireland also has 5 county bor-

Ireland's flag dates from the 1800's. Green represents the country's Roman Catholics; orange, the Protestants of Ulster; and white, unity.

The Irish coat of arms pictures a traditional Irish harp. The harp has been a favorite musical instrument in Ireland for hundreds of years.

WORLD BOOK map

The Republic of Ireland is located in northwestern Europe. It occupies about five-sixths of the island of Ireland.

Ireland map index

Provinces and counties

Connacht (province)* 431,409 E 3
Galway 178,552 F 3
Leitrim 27,035 D 4
Mayo 115,184 D 2
Roscommon 54,592 D 3
Sligo 56,046 D 3
Leinster (province)* 1,852,649 F 6
Carlow 40,988 G 6
Dublin 1,021,449 F 6
Kildare 116,247 F 6
Kilkenny 73,186 G 5
Laois 53,284 F 5
Longford 31,496 E 4
Louth 91,810 D 6
Meath 103,881 E 6
Offaly 59,835 F 5
Westmeath 63,379 E 5
Wexford 102,552 G 6
Wicklow 94,542 F 6
Munster (province)* 1,020,577 H 3
Clare 91,344 G 3
Cork 412,735 H 3
Kerry 124,159 H 2
Limerick 164,569 G 3
Tipperary 136,619 G 4
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Monaghan 52,379 D 5

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Abbeyleix 1,299 G 5
Adare 792 G 3
An Uaimh, see Navan
Anascaul 228 H 2
Annacotty* 532 G 3
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Ardfert 622 H 2
Ardrahan F 3
Arklow 7,987 G 7
Arvagh 331 D 5
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Ashford* 782 F 6
Askeaton* 951 H E
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Athenry 1,612 F 3
Athlone 8,170 E 4
Athy 5,204 F 6
Bailieborough 1,550 D 6
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Balla 368 E 3
Ballaghaderreen 1,270 D 4
Ballina 6,563 D 3
Ballinamore 810 D 4
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Ballyconnell 466 D 4
Ballyhaunis 1,286 E 3
Ballyheigue* 660 H 2
Ballyhooly* 209 I 3
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Ballyliffin* 198 B 4
Ballylinan* 440 G 5
Ballylongford* 523 H 2
Ballymote 1,014 D 4
Ballysadare D 4
Ballynacargy* 240 E 5
Ballyoulster* 392 F 5
Ballyporeen* 319 G 4
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Ballyshannon 2,426 C 4
Baltinglass 1,089 F 6
Banagher 1,423 F 4
Bandon 1,736 I 3
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Bantry 2,777 I 2
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Bellanode* 312 D 5
Belmont* 258 F 5
Belmullet 986 D 2
Belturbet 1,223 D 5
Birdhill G 4
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Blarney 2,043 I 3
Blessington 1,322 F 6
Borrisokane 784 F 4
Boyle 1,695 D 4
Bray 25,096 F 7
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Caher 2,055 H 4
Caherconlish* 559 G 3
Cahersiveen 1,213 I 1
Callan 1,246 G 5
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Campile 426 H 7
Cappamore* 765 H 3
Cappawhite* 391 G 4
Cappoquin* 920 H 5
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Carna F 2
Carndonagh 1,541 A 5
Carrick-macross 1,678 D 6
Carrick-on-Shannon 1,858 D 4
Carrick-on-Suir 5,143 H 5
Carrigaline* 5,893 I 4
Carrigallen* 278 D 4
Carrigans* 243 B 4
Carrigtwohill* 1,272 I 4
Carrowkeel* 229 B 4
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Castleblayney 2,029 D 6
Castlecomer 1,396 G 5
Castleisland 2,207 H 2
Castlerea 1,822 E 4
Cavan 3,332 D 5
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Celbridge* 9,629 F 6
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Claremorris 1,907 E 3
Clifden 808 E 1
Cloghan 496 F 4
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Clondalkin F 6
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Cloyne 731 I 4
Cobh 6,227 I 4
Cong 194 E 3
Cootehill 1,452 D 5
Cork 133,271 I 4
Creeslough B 5
Croom 1,090 G 3
Crosshaven 1,329 I 4
Crossmolina 1,202 D 2
Delvin 309 E 5
Dingle 1,272 H 1
Donegal 2,193 C 4
Drogheda 23,848 E 6
Droichead Nua 11,778 F 6
Dromod D 4
Dublin 502,749 F 7
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Dundalk 25,843 D 6
Dungarvan 6,920 H 5
Dungloe 988 B 4
Dunmanway 1,404 I 2
Dunmore 445 E 3
Dunmore East 1,038 H 5
Dunshaughlin 878 E 6
Durrow 707 G 5
Easky 190 D 3
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Falcarragh 996 B 4
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Glengarriff I 2
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Granard 1,221 E 5
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Hacketstown* 710 G 6
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Headford 800 E 3
Holycross 274 G 4
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Kildare 4,196 F 6
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Kilkenny 8,515 G 5
Killala 674 D 3
Killaloe 956 G 4
Killarney 7,837 H 2
Killorglin 1,229 H 2
Killybegs 1,522 C 3
Kilmallock 1,311 H 3
Kilrush 2,740 G 2
Kingscourt 1,260 D 5
Kinnegad 433 E 5
Kinsale 1,759 I 4
Laytown 3,360 E 6
Leixlip 13,194 E 6
Letterkenny 7,186 B 4
Lifford 1,359 B 5
Limerick 56,279 G 3
Lisdoonvarna 648 F 3
Lismore 715 H 4
Listowel 3,347 G 2
Longford 6,393 E 4
Loughrea 3,271 F 3
Louisburgh 209 E 2
Louth* 373 D 6
Lucan 13,574 F 6
Maam Cross E 2
Macroom 2,363 I 3
Malahide 12,088 E 7
Mallow 6,486 H 3
Manorhamilton 995 C 4
Maynooth 6,027 F 6
Midleton 2,990 I 4
Milford 981 B 5
Millstreet 1,300 H 3
Miltown Malbay 615 G 2
Mitchelstown 3,090 H 4
Moate 1,529 E 5
Mohill 796 D 4
Monaghan 5,750 D 5
Mount Bellew 539 E 4
Mountmellick 2,495 F 5
Mountrath 1,375 F 5
Moville 1,392 B 5
Moyvalley E 6
Muine Bheag 2,573 G 6
Mullingar 8,003 E 5
Naas 11,141 F 6
Navan (An Uaimh) 3,415 E 6
Nenagh 5,525 G 4
New Ross 5,018 H 6
Newcastle* 1,149 E 6
Newcastle West H 3
Newmarket 1,022 H 3
Newmarket-on-Fergus 1,583 G 3
Newport 521 D 2
Newtown Mount Kennedy 2,321 F 7
Oldcastle 847 D 5
Oranmore 1,064 F 3
Oughterard 711 E 3
Passage West 3,410 I 3
Port Laoise 3,618 F 5
Portarlington 3,211 F 5
Portlaw 1,151 H 5
Portmarnock* 9,055 E 6
Portrane* 2,303 E 6
Portumna 1,017 F 4
Ramelton* 989 B 4
Raphoe 1,027 B 5
Rath Luirc 2,646 H 3
Rathangan* 1,270 F 6
Rathcoole* 2,991 F 6
Rathdowney* 1,095 F 5
Rathdrum 1,175 F 6
Rathkeale 1,803 G 3
Rathmelton B 5
Rathmore 528 H 3
Rathnew* 1,389 F 6
Rochfortbridge* 792 E 5
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Rosslare 704 H 6
Rosslare Harbour 891 H 6
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Skerries 7,032 E 7
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Swords 17,705 E 6
Tallow 858 H 4
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Thomastown 1,487 G 5
Thurles 6,687 G 4
Tinahely 594 G 6
Tipperary 5,033 G 4
Tobercurry 1,069 D 3
Tower* 1,158 I 3
Tralee 17,225 H 2
Tramore 6,064 H 5
Trim 1,784 E 6
Tuam 3,448 E 3
Tullamore 8,622 F 5
Tullow 2,277 G 6
Urlingford* 676 G 5
Virginia 699 D 5
Waterford 39,516 H 5
Waterville 475 I 1
Wellington Bridge H 6
Westport 3,688 E 2
Wexford 9,544 H 6
Wicklow 5,847 F 7
Youghal 5,532 I 4

*Does not appear on the map; key shows general location.
†Includes some places without legally defined boundaries.

Sources: 1991 census for provinces and counties; 1986 census for cities and towns.

oughs. The cities of Cork, Dublin, Galway, Limerick, and Waterford make up the county boroughs. Each county and county borough is governed by an elected council and a manager appointed by the national government.

Armed forces. Ireland's army has about 11,200 members. An additional 1,000 people serve in the navy, and about 800 in the air force. All service is voluntary.

People

Ancestry and population. Most of the Irish people are descended from peoples who settled in Ireland during the past 7,000 years. These peoples included Celts, Vikings, Normans, and the British. Each group influenced Irish civilization and helped shape the character of the Irish people.

Most of Ireland's people live in cities and large towns. Dublin, the country's capital, is also its largest city.

Throughout most of Ireland's history, emigration was a major problem. Thousands of people left the country every year because of limited job opportunities there. But in the mid-1900's, the population began increasing slowly. The development of new industries in Ireland as well as the limited number of jobs available in other countries helped check emigration from Ireland. At the end of the 1900's, Ireland's economy began to grow rapidly. Greater job opportunities not only encouraged Irish people to remain in their own country but also encouraged many to return to their homeland.

Language. Ireland has two official languages, English and Gaelic. All the people speak English, and they have a soft accent called a *brogue*. Gaelic is a form of the ancient Celtic language. The Gaelic spoken in Ireland is generally called *Irish*. It almost died out when Britain ruled Ireland. But since Ireland became independent in the early 1900's, many Irish people have attempted to bring the language into wider use. Today, Irish schools teach both Gaelic and English. About 30 percent of the people state that they can speak Gaelic well enough to use it in conversation. But only some of them use Gaelic as their everyday language. The Irish government uses both English and Gaelic for official business. See **Gaelic language**.

Ireland
political map
National Park
International boundary
County boundary
Expressway
Road
Railroad
National capital
Administrative center
Other city or town
WORLD BOOK map
North Atlantic Ocean
IRELAND
NORTHERN IRELAND
SCOTLAND
Irish Sea
St. George's Channel
North Channel
Londonderry
Belfast
Dublin
Galway
Limerick
Cork
Waterford
Sligo
Donegal
Kerry
Clare
Mayo
Roscommon
Leitrim
Monaghan
Cavan
Louth
Meath
Westmeath
Longford
Offaly
Kildare
Wicklow
Laois
Carlow
Kilkenny
Tipperary
Wexford
Dundalk
Drogheda
Bray
Naas
Dún Laoghaire
Lough Foyle
Lough Neagh
Lough Erne
Lough Allen
Lough Ree
Lough Derg
Lough Corrib
Lough Mask
Lough Conn
Shannon
Boyne
Liffey
Barrow
Nore
Suir
Slaney
Blackwater
Lee
Bandon
Kenmare River
Dingle Bay
Bantry Bay
Galway Bay
Clew Bay
Donegal Bay
Sligo Bay
Broad Haven
Killala Bay
Blacksod Bay
Tralee Bay
Ballyheige Bay
Mal Bay
Bertraghboy Bay
Gweebarra Bay
Sheep Haven
Swilly
Foyle
Lough Swilly
Inishmore
Aran Islands
Achill I.
Clare I.
Bear I.
Valentia I.
Sybil Point
Dursey I.
Mizen Head
Clear I.
Old Head of Kinsale
Hags Head
Loop Head
Kerry Head
Slyne Head
Erris Head
Malin Head
Mull of Oa
Mull of Kintyre
Fair Head
Rathlin I.
Tory I.
Aran I.
Rossan Point
Bloody Foreland
Gorumna I.
Inishmore
Valentia I.
Bolus Head
Waterville
Sneem
Kenmare
Killarney
Macroom
Blarney
Youghal
Midleton
Youghal Bay
Knockadoon Head
Helvick Head
Ballycastle
Portstewart
Coleraine
Limavady
Ballymoney
Cushendall
Ballykelly
Glenarm
Larne
I. Magee
Carrickfergus
Newtownabbey
Bangor
Belfast Lough
Strangford Lough
Newtownards
Comber
Lisburn
Dungannon
Fintona
Omagh
Castlederg
Strabane
Lifford
Rathmelton
Milford
Creeslough
Buncrana
Carndonagh
Moville
Ballykelly
Dungloe
Letterkenny
Gweedore
Bunbeg
Falcarragh
Ardara
Glenties
Ballybofey
Raphoe
Donegal
Killybegs
Ballintra
Bundoran
Ballyshannon
Kesh
Irvinestown
Belleek
Enniskillen
Lower Lough Erne
Upper Lough Erne
Manorhamilton
Belcoo
Monaghan
Clones
Keady
Armagh
Portadown
Lurgan
Ballynahinch
Portaferry
Banbridge
Downpatrick
Castlewellan
Newcastle
Dundrum Bay
Newry
Newtownhamilton
Warrenpoint
Kilkeel
Crossmaglen
Cootehill
Belturbet
Ballyconnell
Ballinamore
Carrick-on-Shannon
Boyle
Charlestown
Foxford
Tobercurry
Ballina
Ballymote
Sligo
Easky
Belmullet
Ballycastle
Killala
Bangor
Crossmolina
Keel
Newport
Swinford
Castlebar
Balla
Westport
Louisburgh
Clifden
Cong
Headford
Tuam
Oughterard
Maam Cross
Carna
Ballinrobe
Claremorris
Ballaghaderreen
Castlerea
Ballyhaunis
Roscommon
Dunmore
Athlone
Moate
Mullingar
Kinnegad
Edgeworthstown
Longford
Granard
Dromod
Mohill
Arvagh
Cavan
Ballieborough
Carrickmacross
Kingscourt
Virginia
Ardee
Dunany Point
Dundalk Bay
Irish Sea
Drogheda
Laytown
Slane
Ceanannus Mor (Kells)
Oldcastle
Navan
Athboy
Delvin
Trim
Meath
Balbriggan
Skerries
Rush
Dunshaughlin
Swords
Malahide
Dublin Airport
Maynooth
Leixlip
Lucan
Clondalkin
Dublin Bay
Howth
Dún Laoghaire
Bray
Greystones
Blessington
Poulaphouca Res.
Kilcullen
Newtown Mt. Kennedy
Wicklow
Wicklow Head
Rathdrum
Baltinglass
Arklow
Tinahely
Tullow
Carlow
Muine Bheag
Kilmichael Point
Gorey
Ferns
Cahore Point
Enniscorthy
Wexford
Rosslare
Rosslare Harbour
Carnsore Point
Wexford Harbour
Waterford Harbour
Dunmore East
Tramore
Wellington Bridge
Waterford
Portlaw
Clonmel
New Ross
Carrick-on-Suir
Caher
Fethard
Cashel
Tipperary
Thurles
Holycross
Templemore
Borrisokane
Birr
Portumna
Banagher
Ferbane
Clara
Tullamore
Cloghan
Kilcormac
Portarlington
Droichead Nua
Edenderry
Athy
Port Laoise
Mountmellick
Mountrath
Abbeyleix
Durrow
Castlecomer
Kilkenny
Callan
Graiguenamanagh
Thomastown
Roscrea
Nenagh
Killaloe
Ennis
Newmarket-on-Fergus
Shannon Airport
Kilrush
Scarriff
Ardrahan
Gort
Lisdoonvarna
Milltown Malbay
Ennistymon
Kilronan
Oranmore
Ballinasloe
Athenry
Galway
Loughrea
Kilkee
Ballybunion
Listowel
Ardfert
Abbeyfeale
Rath Luirc
Kilmallock
Adare
Croom
Rathkeale
Newcastle West
Glin
Limerick
Tralee
Castleisland
Killorglin
Killarney
Rathmore
Millstreet
Mallow
Fermoy
Lismore
Dungarvan
Tallow
Cork
Kanturk
Buttevant
Mitchelstown
Newmarket
Dingle
Annascaul
Kerry
Cahersiveen
Killarney National Park
Lough Leane
Cork Airport
Passage West
Cobh
Cloyne
Crosshaven
Bandon
Kinsale
Cork Harbour
Glengariff
Dunmanway
Bantry
Clonakilty
Schull
Skibbereen
Roaringwater Bay
Clonakilty Bay
Kilbeggan
Mullingar
Athlone
Moate
Ballinasloe
Loughrea
Gort
Ennis
Shannon Airport
Kilrush
Kilkee
Tarbert
Listowel
Tralee
Dingle
Killorglin
Killarney
Millstreet
Mallow
Fermoy
Lismore
Dungarvan
Tallow
Youghal
Midleton
Cork
Blarney
Macroom
Kenmare
Sneem
Waterville
Bolus Head
Valentia I.
Cahersiveen
Dingle Bay
Tralee Bay
Ballyheige Bay
Kerry Head
Loop Head
Hags Head
Slyne Head
Erris Head
Malin Head
Mull of Oa
Mull of Kintyre
Fair Head
Rathlin I.
Tory I.
Aran I.
Rossan Point
Bloody Foreland
Gorumna I.
Inishmore
Aran Islands
Achill I.
Clare I.
Bear I.
Valentia I.
Sybil Point
Dursey I.
Mizen Head
Clear I.
Old Head of Kinsale
Helvick Head
Knockadoon Head
Youghal Bay
Cork Harbour
Waterford Harbour
Wexford Harbour
Dundalk Bay
Irish Sea
St. George's Channel
North Channel
North Atlantic Ocean
North
10 West Longitude
8
6
54
52
54 North Latitude
0 50 100 150 200 Miles
0 50 100 150 200 250 300 Kilometers

Irish Tourist Board

Grafton Street is a fashionable shopping district in Dublin. The street's clothing stores, antique shops, and tearooms attract many shoppers and tourists.

Way of life. In Irish cities and towns, most of the people live in houses. Others live in apartments, and apartment living is increasing. Typical houses in Ireland are built of brick or concrete and have four to seven rooms. In rural areas of Ireland, modern houses have replaced most of the traditional thatch-roofed cottages that once dotted the countryside.

The Roman Catholic Church has long played a major role in Irish social life. Almost every Irish city has a Catholic cathedral, and nearly all the towns and villages have a Catholic church. Most people attend church regularly. At their local church, the people join religious societies and take part in social gatherings and other activities.

Many of the Irish enjoy visiting their neighborhood *pub* (public house). People gather in the country's pubs to drink beer and whiskey, talk with friends, and listen to music.

Large numbers of young people in Ireland once remained single and lived with their parents until they were over the age of 30. Farmland and jobs were scarce, and few young people could afford to marry and raise families. However, marriage practices have changed, and today young people marry earlier than they did in the past.

Food and drink. Irish cooking is simple. Principal foods include beef, bread, chicken, fruit, mutton, pork, and potatoes and other vegetables. Potatoes grow well in the climate of the country and have been an important food in Ireland for hundreds of years.

One of Ireland's most famous dishes is *Irish stew.* This dish is made by boiling layers of potatoes, onions, and pieces of mutton in a covered pot. Another traditional Irish meal consists of boiled salt pork, cabbage, and potatoes.

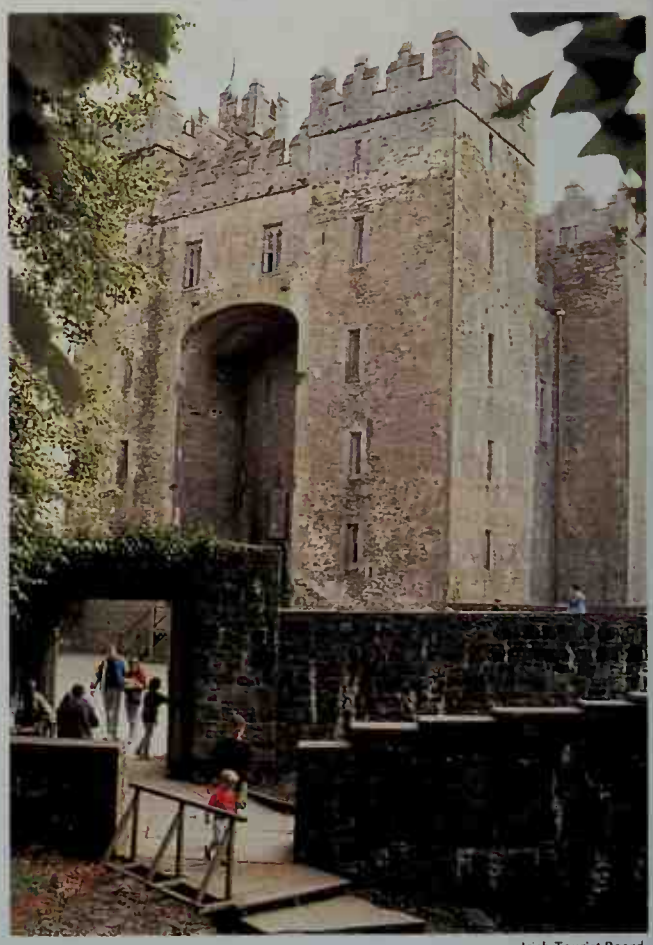
The favorite alcoholic drink in Ireland is beer. A type of beer called *stout* is especially popular. The Irish use barley malt to make *Irish whiskey,* a world-famous liquor. A drink called *Irish coffee* is made with coffee, Irish whiskey, brown sugar, and cream.

Recreation. Many Irish people are interested in horses and in sports involving horseback riding. The country has about 30 race tracks, and races are held about 170 days a year. Ireland's most famous horse races are the Irish Derby, held at Kildare in late June, and the Irish Grand National, held near Dublin on the Monday after Easter. The Irish also enjoy horse shows. The famous Royal Dublin Society Horse Show is held in Dublin each August. The show attracts spectators and contestants from many countries.

Ireland's favorite team sports are soccer, which the Irish call football; *Gaelic football,* which resembles soccer; and *hurling,* which is similar to field hockey. The Gaelic Athletic Association supervises the country's many amateur teams in Gaelic football and hurling. Other popular team sports include *camogie,* which is also similar to field hockey and is played by women; *cricket,* which is played with bats and a ball; and *rugby,* a form of football. Boxing has long been popular in Ireland. Many of the Irish also enjoy cycling, fishing, golf, sailing, swimming, tennis, and recreational walking. See **Cricket; Field hockey; Rugby football; Soccer.**

Religion. About 95 percent of the Irish people are Roman Catholics. The country's largest Protestant church is the Church of Ireland. Other Protestant churches in Ireland include the Methodist and Presbyterian churches.

Education. Irish law requires children from the ages of 6 to 15 to go to school. Nearly all Ireland's schools are controlled by private organizations, chiefly the Roman Catholic Church and the Church of Ireland. But the government of Ireland provides funds to support the



Irish Tourist Board

Bunratty Castle, near Limerick, is a restored Irish castle of the 1400's. Visitors can see the castle's art and furnishings, watch craft demonstrations, and take part in medieval banquets.

Irish Tourist Board

Horse racing is a popular sport in Ireland. Curragh Racecourse, *shown here*—near Naas in County Kildare—is the site of the famous, annual Irish Derby race.

schools, and most primary and secondary education is free. Most secondary schools are either boys' schools or girls' schools. The minister of education, a member of the Cabinet, supervises the government's role in the educational system.

For many years, Ireland has had separate secondary and vocational schools. *Secondary schools* provide general education, and *vocational schools* offer technical and general training. In some areas, *comprehensive schools* and *community schools* have been set up to provide both types of education under one roof.

Ireland has four universities—Dublin City University, the University of Limerick, the National University of Ireland, and the University of Dublin. The National University, which has colleges in Dublin, Galway, and Cork, has a total enrollment of about 30,000 students. It also has six other *recognized* (associated) colleges in Ireland. One of them, St. Patrick's College in Maynooth, includes the national seminary for the Roman Catholic Church. The University of Dublin, also called Trinity College, has about 10,000 students, plus four recognized colleges.

The arts. Ireland has produced outstanding artists in many fields, but the country is especially famous for its writers. Many of Ireland's greatest writers lived during the late 1800's and early 1900's, a period known as the Irish Literary Revival. James Joyce, George Augustus Moore, George Russell, George Bernard Shaw, William Butler Yeats, and other writers of that period brilliantly described Irish life and thought.

In 1904, the famous Abbey Theatre opened in Dublin under the leadership of Yeats and Lady Gregory. This theater presents plays written by such outstanding Irish dramatists as Padraic Colum, Sean O'Casey, and John Millington Synge. Other famous Irish writers include Brendan Behan, Frank O'Connor, Edna O'Brien, and Sean O'Faolain. For more information on Ireland's literary achievements, see **Drama** (Irish drama); **Irish literature.**

Irish censorship laws allow a board of censors to prohibit any work it considers improper. As a result of this censorship, the works of many famous Irish writers were prohibited in their native country. Today, censorship has been relaxed considerably.

The Royal Hibernian Academy, founded in Dublin in 1821, has encouraged many Irish painters. A group of Irish landscape painters became well known during the 1900's. The group included John Keating, Maurice MacGonigal, Sean O'Sullivan, and Estella Solomon. Other famous Irish painters of the 1900's included Thurloe Con-

© Thomas Braise, The Stock Market

The University of Dublin, also called Trinity College, was founded in 1592. It is one of Ireland's four universities.

Shostal

Celtic crosses are famous Irish artworks. Some of them were created for artistic and religious expression about 1,000 years ago. Later, many were carved to serve as grave markers.

nolly, Gerard Dillon, Daniel O'Neill, and Jack Yeats.

For hundreds of years, Irish craftworkers have produced beautifully decorated jewelry, utensils, and religious objects. Ireland's most famous artworks and historical landmarks include *Celtic crosses*. Some of these beautifully carved stone monuments date back about 1,000 years and are found throughout the country. Irish weavers have long been famous for their high-quality linen and woolen fabrics.

Irish folk music is popular throughout the world. It includes songs of love, sorrow, and longing for home, as well as music for such lively dances as reels and jigs. The famous Irish-born tenor John McCormack helped make many Irish songs popular.

Land and climate

The Republic of Ireland occupies about five-sixths of the island of Ireland. It covers 27,137 square miles (70,284 square kilometers). Northern Ireland lies to the northeast and occupies the rest of the island of Ireland. The Irish Sea and St. George's Channel separate Ireland from the island of Great Britain to the east. The Atlantic Ocean borders the country on the north, west, and south.

Surface features. Ireland has three main surface features—lowlands, mountains, and coasts.

The lowlands cover most of central Ireland. They include some wooded areas but consist principally of gently rolling farmlands, which are mainly pasture. They also include *peat bogs* (former swamps composed of partly decayed plants). Peat bogs cover about a tenth of Ireland. Most of them are located in the central and western parts of the country.

Most of Ireland's mountains rise near the coasts and border the lowlands. The chief mountain ranges are the Donegal Mountains in the northwest, the Mountains of Mayo and the Mountains of Connemara in the west, the Mountains of Kerry in the southwest, and the Wicklow Mountains in the east. Ireland's highest peak, 3,414-foot (1,041-meter) Carrauntoohill, rises in the Mountains of Kerry.

Many inlets and bays cut deeply into the west coast of Ireland. Because of them, no point in the country is more than 70 miles (110 kilometers) from the sea. Parts of the coast are lined with high cliffs of solid rock. Two large bays on the west coast, Galway Bay and the mouth of the River Shannon, provide harbors for the ports of Galway and Limerick. Other important bays on the country's west coast include Bantry, Clew, Dingle, Donegal, and Sligo bays. Hundreds of small islands lie off the west coast of Ireland. The largest of these islands include Achill Island, the Aran Islands, and Valentia Island.

The south and east coasts are straighter and less rugged than the west coast. On the south coast, the ports of Cork and Waterford lie on excellent natural harbors. Dublin Bay, on the east coast, provides a harbor for Dublin, the chief Irish port.

Rivers and lakes. The River Shannon is Ireland's longest river. The Shannon begins in northwestern Ireland and flows southwest 230 miles (370 kilometers) into the Atlantic Ocean (see **Shannon, River**). The River Liffey begins in the Wicklow Mountains, winds northeast 75 miles (121 kilometers), and flows into the Irish Sea at Dublin. The mouth of this river forms Dublin Bay. Other Irish rivers include the Barrow, Nore, and Suir in the southeast; the Boyne in the northeast; and the Moy in the northwest.

Most of Ireland's lakes lie in the west. The lakes are called *loughs* (pronounced *lahks*). Three major lakes—Lough Allen, Lough Ree, and Lough Derg—lie along the course of the River Shannon. The scenic Lakes of Killarney in the southwest consist of Lower Lake, Muckross Lake, and Upper Lake. See **Lakes of Killarney**.

Climate. Ireland has a mild, wet climate. Temperatures average about 41 °F (5 °C) in the winter and about 59 °F (15 °C) in summer. Ireland's climate is influenced by the North Atlantic Current, which is a warm ocean current that flows north past the island. In winter, westerly winds blow across the current and bring warmth to the country. Ireland lies farther north than the New England states of the United States. But winters in Ireland are warmer than those in New England, partly because of the North Atlantic Current. In summer, ocean waters are cooler than the land, and westerly winds blowing across the waters help keep temperatures mild.

The ocean winds also bring much rain to Ireland. The heaviest rains fall in the mountainous regions along the west coast. The rainfall there averages about 60 inches

© Dave C. Houser

The dramatic Cliffs of Moher rise nearly 700 feet (210 meters) from the Atlantic Ocean on the west coast of County Clare. No part of the small island country of Ireland is more than 70 miles (110 kilometers) from the sea.

Physical features

Achill Island	C	1
Aran Islands	D	2
Arderin (mountain)	E	4
Bantry Bay	G	2
Barrow, River	E	5
Blackwater, River	F	3
Bloody Foreland	A	3
Blue Stack Mountains	B	4
Brandon Mountain	F	1
Bog of Allen	D	5
Boyne, River	D	5
Carrauntoohil (peak)	F	2
Clare, River	D	3
Clew Bay	C	2
Cork Harbour	G	3
Cuilcagh Mountain	C	4
Dingle Bay	F	1
Donegal Bay	B	3
Donegal Mountains	B	3
Dundalk Bay	C	5
Dublin Bay	D	6
Feale, River	F	2
Foyle, River	B	4
Galway Bay	D	2
Grand Canal	D	4
Inishowen Head	A	4
Irish Sea	D	6
Iron Mountains	C	4
Keeper Hill	E	3
Knockmealdown Mountains	F	3
Lakes of Killarney	F	2
Laune, River	F	2
Lee, River	C	3
Liffey, River	D	5
Loop Head	E	2
Lough Allen (lake)	C	3
Lough Conn (lake)	A	4
Lough Corrib (lake)	D	3
Lough Derg (lake)	E	3
Lough Derravaragh (lake)	D	4
Lough Foyle (inlet)	A	4
Lough Mask (lake)	D	2
Lough Ree (lake)	D	3
Lough Swilly (inlet)	A	4
Lugnaquilia Mountain	E	5
Mizen Head	G	2
Mount Errigal	A	3
Mount Leinster	E	5
Mountains of Connemara	D	2
Mountains of Kerry	F	2
Mountains of Mayo	C	2
Mouth of the Shannon	E	2
Moy, River	C	3
Mullet Peninsula	C	1
Mweelrea (mountain)	D	2
Nore, River	E	4
North Channel	A	6
Poulaphuca Reservoir	E	5
Royal Canal	D	5
St. George's Channel	F	6
Saltee Islands	F	5
Shannon, River	D	4
Skelligs, The	G	1
Slaney, River	E	5
Slieve Bloom Mountains	E	4
Slieve Mish Mountains	F	2
Sligo Bay	C	3
Suir, River	F	4
Tara Hill	D	5
Valentia Island	F	1
Waterford Harbour	F	4
Wexford Harbour	F	5
Wicklow Head	E	6
Wicklow Mountains	E	5

(150 centimeters) a year, with some areas having as much as 100 inches (250 centimeters) a year. The lowlands have about 35 inches (90 centimeters) of rain a year. Flooding is a problem in some parts of the country during rainy periods.

The southern and western parts of Ireland have a longer growing season than the rest of Ireland because of their mild climate and plentiful rainfall. In many areas, pasturelands can be used the year around.

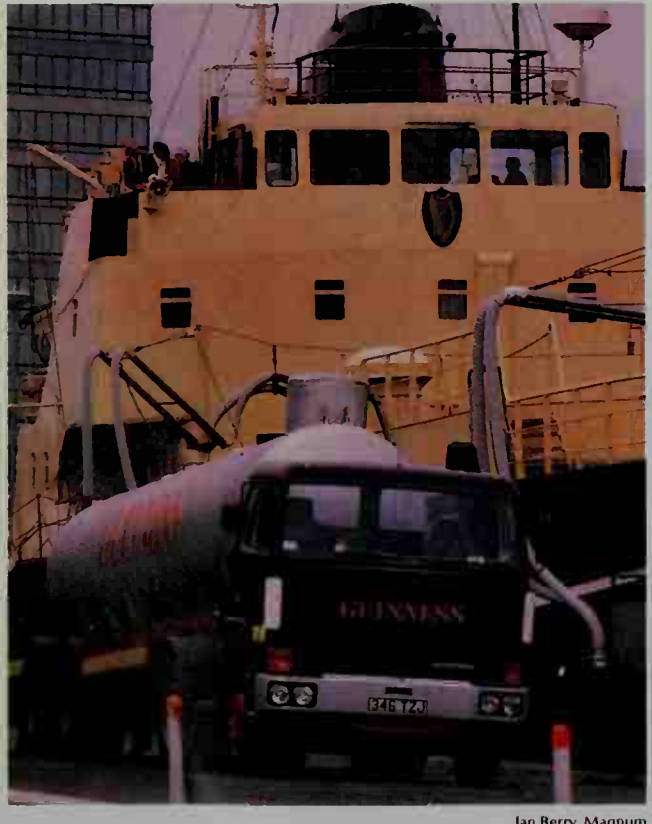
Economy

The economy of Ireland depends heavily on service industries and manufacturing. For hundreds of years, nearly all the Irish people made their living from farming, and many still do. However, during the 1900's, agriculture gradually declined in importance, and the country's manufacturing industries and service industries increased in importance.

Natural resources. Ireland's chief natural resources are the soil and pastures of its lowlands. The country has deposits of lead, zinc, and marble and other building stone. One of the world's largest lead-zinc mines is near Navan. Peat is used as a fuel to generate electric power and for heating and cooking. Ireland has little coal. Natural gas from off the southern coast is also used.

Forests once covered much of the country, but most of the trees were cut down for lumber or to clear farmland. However, the Irish government has been gradually restoring these forests by planting hundreds of thousands of trees.

Service industries are economic activities that provide services, rather than produce goods. Service industries taken together account for more than half of the value of Ireland's economic production. More than half of Ireland's workers are employed in service industries. The most valuable service industries in Ireland are community, social, personal, business, and financial services. This group of services includes such activities as education, health care, insurance, real estate, and the operation of repair shops and beauty salons. Trade, transportation, and communication also contribute heavily to Ireland's economy and employ much of the work force. Ireland attracts many tourists, and their spending benefits several service industries.



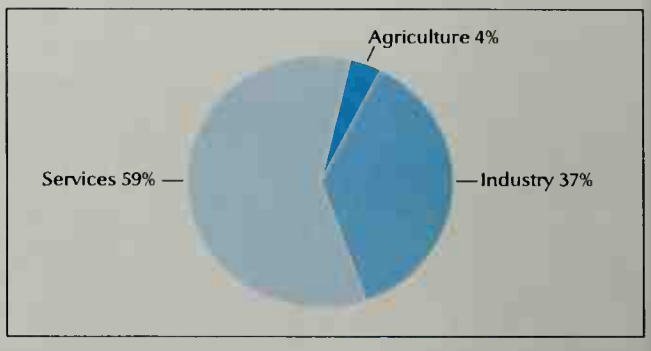
Ian Berry, Magnum

Guinness Stout, Ireland's most popular brand of stout, is an important export. Ireland's exports also include chemicals, computers, dairy products, meat, and textiles.

Manufacturing. Ireland has few heavy manufacturing industries. Small and medium-sized factories and workshops produce most manufactured goods. Many factories are in the Dublin and Cork areas. Ireland's manufactured goods include alcoholic beverages, chemicals, clothing, computers and other electronic equipment, machinery, medicines, metal products, paper, printed materials, processed foods, and textiles.

The Irish government follows policies designed to

Ireland's gross domestic product



Ireland's gross domestic product (GDP) was $93,535,000,000 in 1999. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, social, personal, business, and financial services; government; wholesale and retail trade, and transportation and communication. *Industry* includes construction, manufacturing, mining, and utilities.. *Agriculture* includes agriculture, forestry, and fishing.

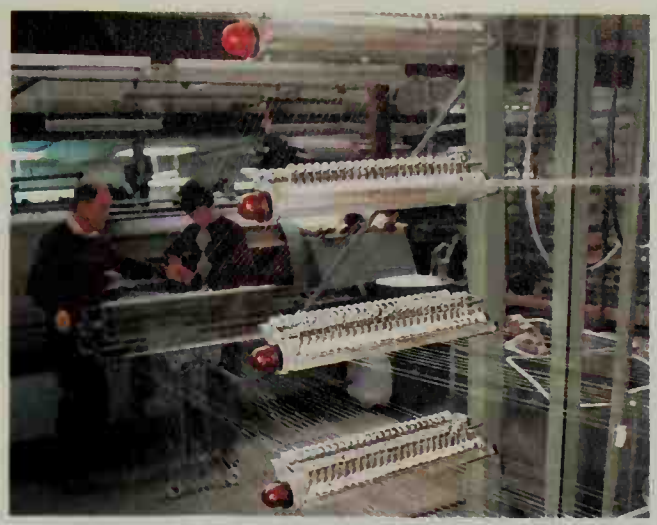
Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers	
		Number of persons	Percent of total
Community, social, personal, business, & financial services	39	508,000	32
Manufacturing, mining, & utilities	37	308,900	19
Transportation, & communication	16	96,000	6
Agriculture, forestry, & fishing	4	135,900	9
Government	4	74,400	5
Wholesale & retail trade	*	325,900	20
Construction	†	142,100	9
Total	100	1,591,200	100

*Included in Transportation & communication.
†Included in Manufacturing.
Figures are for 1999.
Sources: International Monetary Fund; International Labour Office.

Marc & Evelyne Bernheim, Rapho Guillumette

The potato harvest has long been important to Ireland's economy. Ireland's other major agricultural products include barley, beef and dairy cattle, hay, hogs, and milk.



Richard Laird, FPG

Textile manufacturing is one of Ireland's leading industries. In this factory in Donegal, a small town in northwestern Ireland, workers weave wool fibers into famous Irish tweed.

develop the nation's industries. It encourages them to manufacture goods for export. The government also encourages foreign firms to build plants in Ireland.

Agriculture and fishing. Farms cover more than two-thirds of Ireland. Most of the farmland is used as pasture. The country grows enough food to feed its people and also for export. Major agricultural products include barley, beef and dairy cattle, hay, hogs, milk, potatoes, poultry, sheep, sugar beets, and wheat. Irish farmers raise some of the world's finest cattle and horses. The waters along Ireland's coasts are excellent fishing areas. The principal fishes and shellfish caught in Irish waters include cod, haddock, herring, lobsters, mackerel, plaice, prawns, rays, salmon, and whiting.

Transportation and trade. Ireland has a good road and railway network. The country has an average of about one automobile for every four people. Dublin Airport is the nation's busiest airport. Shannon Airport, near Limerick, handles many transatlantic flights. The ports of Cork, Dublin, Limerick, Rosslare, and Waterford handle most of Ireland's foreign trade.

Ireland's main trading partners are the United Kingdom, the United States, Germany, and France. The country's most important exports include chemicals, computers, dairy products, meat, and textiles. Major imports include fruits, grains, machinery, motor vehicles, petroleum, and plastics. Ireland is a member of the European Union, an association of European nations that cooperate with one another in economic and political matters.

Communication. Ireland has eight daily newspapers. The Irish Constitution guarantees freedom of the press. The government funds the main radio and television networks. Local radio stations are privately owned. Almost all Irish families own a TV set and one or more radios. Television owners pay yearly license fees to help support the government TV and radio agency, Radio Telefis Éireann (RTE). Government-supported companies run the postal and telephone services.

History

Historians believe that the first people to live in Ireland came from the European mainland about 6000 B.C. They settled on the northeast coast, near what is now Larne in Northern Ireland, and then moved inland along the rivers. They lived by hunting and fishing. These first settlers were followed by people who grew crops and raised animals. Later, people who made gold ornaments, pottery, and tools settled in the country.

About 400 B.C., Celtic tribes from Britain and the European mainland invaded Ireland. The Celts gained control of the island and divided it into small kingdoms called *tuatha*. The rulers of the kingdoms often fought over their territories and boundaries. One ruler was given the title *árd-fí* (high king). See **Celts.**

Saint Patrick brought Christianity to Ireland in the A.D. 400's. Saint Patrick was born in Britain and was taken to Ireland as a slave in the early 400's. After six years of slavery, he escaped to France, where he studied for the priesthood. He returned to Ireland as a Christian missionary in 432. The Irish accepted Christianity and came to regard Patrick as their *patron* (guardian) saint. Today, his feast day, March 17, is celebrated as a national holiday.

Saint Patrick also introduced the Roman alphabet and Latin literature into Ireland. After his death, about 461, Irish monasteries flourished as centers of learning.

The Viking raiders. About 795, Vikings began raiding the east and south coasts of Ireland. They settled near harbors and established Ireland's first towns, including what are now Cork, Dublin, Limerick, and Waterford. They also raided the countryside, robbing and destroying monasteries. At first, the Irish people could do little to defend themselves against the well-armed Vikings. But in 1014, the Irish high king, Brian Boru, organized the princes of several kingdoms and defeated the Vikings at Clontarf (now part of Dublin). The Vikings were allowed to remain in their seaport towns and, in time, were absorbed by the Irish people.

The Norman invaders. In the 1160's, the high king, Turlough O'Connor, overthrew Dermot MacMurrough, king of Leinster in southeastern Ireland. Dermot asked Henry II, the Norman king of England, for help in regaining his kingdom. Henry gave Dermot permission to recruit Norman soldiers, and Dermot promised the Nor-

mans a share of the land they helped him reconquer. With Norman help, he recovered his kingdom in 1170.

After Dermot died in 1171, a Norman baron named Strongbow declared himself king of Leinster. Other Norman barons then also seized Irish land. Henry II wanted to be sure that the barons remained loyal to him, so he traveled to Ireland in 1171 and forced them to recognize him as lord of Ireland.

By the 1300's, the Normans held nearly all of Ireland. But the Normans' loyalty to England weakened as they intermarried with the Irish and adopted their language and customs. By the early 1400's, England actually controlled only a small area around Dublin called the *Pale*.

The conquest of Ireland. In 1534, Henry VIII tried to regain England's influence in Ireland. He took all power away from the Earls of Kildare, Norman noblemen who had long controlled English interests in Ireland, and set up more direct control. In 1541, Henry succeeded in having Ireland's Parliament declare him king of Ireland. He established English laws in Ireland and tried, with little success, to introduce Protestantism in the country.

Henry's son, Edward VI, and his daughters, Mary I and Elizabeth I, continued their father's policies throughout the 1500's. Mary tried to strengthen English rule by beginning what is known as the *plantation of Ireland*. She seized land in Leix and Offaly counties in central Ireland and gave it to English settlers. She also renamed the counties Queen's County and King's County. Elizabeth, like her father, attempted to establish Protestantism in Ireland. She outlawed Roman Catholic services and executed a number of bishops and priests. But as a result, the Irish Catholics became more united and more bitterly anti-English than ever.

In the late 1500's, a series of revolts against the English broke out in Ulster, a large province in northern Ireland. The revolts were led first by Shane O'Neill, an Irish chieftain, and later by his nephew, Hugh O'Neill, Earl of Tyrone. Elizabeth put down the last Ulster revolt in 1603.

Religious persecution. James I, who followed Elizabeth as ruler of England in 1603, tried to prevent further revolts by continuing the plantation of Ireland. He seized land in Ulster and gave it to English and Scottish Protestants, creating the Protestant majority that still exists in Northern Ireland. There were also plantations in other parts of the country.

As a result of the plantations, Roman Catholics throughout Ireland feared that they would lose their land. The Catholics also feared that the Puritans, who were gaining power in England, would persecute them. In 1641, the Irish began a revolt against England. Oliver Cromwell, who had become the Puritan ruler of England, finally crushed the revolt in 1649. Cromwell then gave even more land to English Protestants and deprived the Catholics of many political rights.

After James II, a Catholic, became king of England in 1685, he abolished many of the anti-Catholic laws established earlier. But in 1688, the English people, most of whom were Protestants, forced James to give up the throne. William III, a Protestant, became king in 1689. James went to France and then to Ireland to organize an army to fight the English. But Protestants in Ulster supported William and helped the English defeat James in the Battle of the Boyne, northwest of Dublin, in 1690.

Following William's victory, more land was taken from Irish Catholics. By 1704, Catholics held only about a seventh of the land. Catholics also were forbidden to purchase or inherit land. They were excluded from the Irish Parliament and the army, and were restricted in their rights to practice Catholicism.

Union with Britain. During the 1700's, the British kept tight control over Ireland and limited the powers of the Irish Parliament. Many Irish Protestants objected to the restrictions, and Parliament, led by Henry Grattan, demanded legislative freedom. Britain met the demands in 1782, and the all-Protestant Irish Parliament ruled the country for the next 18 years. Parliament restored to Catholics their rights to hold land and lifted the restrictions on their religious rights. But it refused to give them any political rights.

Some Protestants in Parliament tried to gain more rights for Catholics. After their attempts failed, they formed a group called the United Irishmen. At first, this group sought equal rights for all Irish people. Later, it demanded complete independence for Ireland from British rule. In 1798, the United Irishmen staged an unsuccessful rebellion. After the rebellion, the British prime minister, William Pitt, persuaded the British and Irish parliaments to pass the Act of Union. Under the act, which went into effect in 1801, Ireland officially became part of the United Kingdom of Great Britain and Ireland. The Irish Parliament was then ended, and Ireland sent representatives to the British Parliament. In 1829, Daniel O'Connell, an Irish Catholic leader, helped Catholic men win the right to serve in the British Parliament and to hold most other public offices.

The potato famine. During the early 1800's, Ireland's population grew rapidly. There were few industries, so the country depended largely on agriculture. Most of the people lived as tenants on small farms. They had to give much of what they produced to their landlords as rent. Most of the tenant farmers struggled to subsist on what was left from their production.

Because of their poverty, many of the Irish people

Engraving from the *London Illustrated News*, Oct. 5, 1851. Radio Times Hultoo Picture Library, London

About 1¼ million Irish left their homeland because of the potato famine of the 1840's. The emigrants above are awaiting ships to take them to Canada and the United States.

depended largely on potatoes for food. Some raised animals and grains to pay their rents. From 1845 to 1848, Ireland's potato crop failed due to a plant disease. About 1 million people died of starvation or disease, and about $1\frac{1}{4}$ million more left the country.

The British government, under pressure from various Irish groups, gradually passed laws to help the Irish. These laws protected tenants' rights and established fair rents. Later laws provided financial help so that tenants could buy land from their landlords.

The Easter Rising. During the late 1800's, some Irish people began to demand *home rule* for their country. Under home rule, Ireland would have remained part of Britain but would have had its own parliament for domestic affairs. The British Liberal Party favored the plan. But Protestants in Ulster opposed it because they feared a Catholic parliament. The British Parliament defeated home rule bills in 1886 and 1892.

In 1905, an Irish journalist named Arthur Griffith founded a political organization called *Sinn Féin,* meaning *We Ourselves.* The organization insisted that the Irish be allowed to govern themselves. The Irish Republican Brotherhood (IRB), a secret organization that wanted a completely independent Irish republic, also was active in the early 1900's. Members of the IRB became known as *republicans.*

In spite of opposition from Ulster Protestants, the British Parliament finally passed a home rule bill in 1914. But the outbreak of World War I (1914-1918) prevented it from taking effect. Most of the Irish people supported Britain during the war. But the republicans, led by Patrick Pearse, believed that the war gave Ireland a chance to gain independence. They began a rebellion in Dublin on Easter Monday 1916. Fighting raged for a week before British troops defeated the rebels. The British executed 15 republican leaders after the uprising.

At first, the Easter Rising received little support from Ireland's people. But the executions created great sympathy for the republican movement. In 1918, the republicans gained control of Sinn Féin and won 73 of Ireland's 105 seats in the British Parliament. But instead of going to London to take their seats in Parliament, the new members met in Dublin. They called themselves the *Dáil Éireann* (House of Representatives) and declared all Ireland an independent republic on Jan. 21, 1919. Following the declaration, fighting broke out between the Irish rebels and British forces.

The Irish Free State. In 1920, the British Parliament passed the Government of Ireland Act. This act divided Ireland into two states—one consisting of 6 counties of Ulster and the other consisting of 3 counties of Ulster and 23 southern counties. Each state was to remain part of Britain and have some powers of self-government. The 6 Ulster counties, which had a Protestant majority, accepted the act and formed the state of Northern Ireland. The Dáil Éireann rejected the act, and southern Ireland began fighting for complete independence.

The Irish Republican Army (IRA), as the rebels were called, attacked British army installations and government buildings. The British responded with tough police called Black and Tans because they wore black-and-tan uniforms. They were extremely cruel in dealing with the rebels and were bitterly hated by the Irish people. Finally, in 1921, Britain and the rebels agreed to a treaty that allowed southern Ireland to become a *dominion* (self-governing country) of the British Commonwealth called the Irish Free State.

The Irish people were sharply divided over the treaty that created the Irish Free State. One group, led by Eamon de Valera, wanted complete independence from Britain and union with Northern Ireland. The other group, first led by Michael Collins and later by William T. Cosgrave, supported the treaty. In 1922, civil war broke out. But the fighting stopped in 1923, and the two groups formed opposing political parties. De Valera headed the Sinn Féin political party, and Cosgrave led one called Cumann na nGaedheal (Community of Gaels). The Irish Free State outlawed the IRA. But some Irish people continued to belong to the organization and engaged in periodic guerrilla warfare against the British.

From 1922 until 1932, Cosgrave served as president of the Executive Council, which governed the Irish Free State. His government improved the Irish economy and established close trade relations with Britain.

In 1926, De Valera resigned from Sinn Féin and founded a new party called Fianna Fáil (Soldiers of Destiny). In the election of 1932, Fianna Fáil gained control of the Irish Parliament, and De Valera became president of the Executive Council. Between 1932 and 1937, De Valera cut most of the ties between the Irish Free State and Britain. He did away with the oath of allegiance to the British monarch and abolished the office of British governor general of Ireland.

In 1937, De Valera's government adopted a new constitution that described Ireland as a "sovereign, independent, democratic state" and changed the state's name from Irish Free State to Éire, which is Ireland in English. The Constitution adopted the name prime minister for the office that had been called president of the Executive Council. De Valera became prime minister under the Constitution. Ireland remained neutral during World War II (1939-1945), but thousands of Irish joined the British armed forces.

The Republic of Ireland. In 1948, John A. Costello, the leader of Fine Gael (Gaelic People, formerly Cumann na nGaedheal), became prime minister. On April 18,

Manchester Evening News

Crowds watched fighting on Dublin's O'Connell Street during the civil war of 1922 and 1923. Disagreements over the treaty that created the Irish Free State caused the war.

Keystone

The Nelson Pillar, a Dublin landmark honoring the British Lord Horatio Nelson, was damaged by an explosion in 1966. People opposed to British control of Northern Ireland set the blast.

1949, his government cut all ties with Britain and declared Ireland an independent republic.

Fianna Fáil and De Valera returned to power in 1951, lost to Fine Gael and Costello in 1954, and then returned to power again in 1957. In 1959, De Valera resigned as prime minister and was elected president. Fianna Fáil kept control of Parliament until 1973. Since then, control of Ireland's government has periodically switched back and forth between Fine Gael and Fianna Fáil. Usually, these parties have had to form coalitions with smaller groups to have a majority of the votes in Parliament. See the table *Prime ministers of Ireland* in this section for a listing of the prime ministers and their parties.

During the late 1960's, widespread violence broke out between Protestants and Catholics in Northern Ireland. IRA members played a major role in the fighting. They staged bombings, kidnappings, and other terrorist acts in Northern Ireland and, to a lesser extent, in Ireland. Many people in Ireland and many Catholics in Northern Ireland still want their states to reunite. However, most of Northern Ireland's people are Protestants and want their land to remain a part of the United Kingdom.

In 1973, Ireland joined the European Community (EC), an economic organization of European nations. In 1993, Ireland and the other EC countries formed the European Union, which works for both economic and political cooperation among its members. The EC was incorporated into the European Union (see **European Union**).

In 1985, Britain and Ireland signed a pact called the Anglo-Irish Agreement. The pact provided for the Republic of Ireland to have an advisory role—but no direct powers—in Northern Ireland's government.

In the 1980's, Ireland's economy struggled with high unemployment, and many people left Ireland to find work elsewhere. In 1991, the government introduced a program to stimulate economic growth. After it was introduced, the economy began to grow steadily. By the late 1990's, Ireland had one of the strongest economies in Europe. From 1990 to 1997, Mary Robinson served as Ireland's first female president.

Recent developments. In 1998, negotiations on Northern Ireland concluded in an agreement that promised an end to the conflict in the troubled region. The talks ended the Anglo-Irish Agreement and established a North-South Ministerial Council with representatives from Ireland and Northern Ireland. Full implementation began in late 1999. The United Kingdom ended total direct rule of Northern Ireland, transferring control of most local matters to the new Northern Ireland Assembly. The Republic of Ireland, in turn, gave up its claim to Northern Ireland.

Desmond A. Gillmor and Brendan O'Leary

Related articles in *World Book* include:

Biographies

For Irish authors, see the Irish literature article.

Berkeley, George	Emmet, Robert	O'Connell, Daniel
Boyle, Robert	Grattan, Henry	Parnell, Charles S.
Brian Boru	Griffith, Arthur	Patrick, Saint
Costello, John A.	Holland, John P.	Robinson, Mary
De Valera, Eamon		

Prime ministers of Ireland

Name	Party	Dates served
William T. Cosgrave	Cumann na nGaedheal	1922-1932*
Eamon de Valera	Fianna Fáil	1932-1948*
John A. Costello	Fine Gael	1948-1951
Eamon de Valera	Fianna Fáil	1951-1954
John A. Costello	Fine Gael	1954-1957
Eamon de Valera	Fianna Fáil	1957-1959
Sean Lemass	Fianna Fáil	1959-1966
John M. Lynch	Fianna Fáil	1966-1973
Liam Cosgrave	Fine Gael	1973-1977
John M. Lynch	Fianna Fáil	1977-1979
Charles Haughey	Fianna Fáil	1979-1981
Garret FitzGerald	Fine Gael	1981-1982
Charles Haughey	Fianna Fáil	1982
Garret FitzGerald	Fine Gael	1982-1987
Charles Haughey	Fianna Fáil	1987-1992
Albert Reynolds	Fianna Fáil	1992-1994
John Bruton	Fine Gael	1994-1997
Bertie Ahern	Fianna Fáil	1997-

*Before 1937, the prime minister was called the president of the Executive Council.

Important dates in Ireland

c. 400 B.C. Celtic tribes invaded Ireland.
A.D. 432 Saint Patrick brought Christianity to Ireland.
c. 795 Vikings began raiding Ireland.
1014 Brian Boru defeated the Vikings at Clontarf.
1541 Henry VIII was declared king of Ireland by an Irish Parliament that was led by nobles who favored English rule.
1649 Oliver Cromwell crushed an Irish revolt against England and took land and rights from Irish Catholics.
1690 The English defeated James II and Irish forces in the Battle of the Boyne.
1801 Ireland became part of the United Kingdom of Great Britain and Ireland.
1845-1848 A potato blight and the starvation and disease that followed killed about 1 million people.
1916 The Easter Rising against British rule erupted in Dublin.
1921 Ireland became a dominion of the British Commonwealth called the Irish Free State.
1949 Ireland declared itself a republic.
1990-1997 Mary Robinson was Ireland's first female president.
1999 Ireland began taking part in new governing bodies created by the Northern Ireland peace agreement.

Cities and towns

Cork	Dún Laoghaire	Killarney	Tipperary
Dublin	Galway	Limerick	Waterford

Other related articles

Banshee	Emerald Isle	Lakes of Killarney
Blarney Stone	Fenian movement	Northern Ireland
Boyne, Battle of the	Gaelic language	Peat (picture: Peat bogs)
Celts	Gaels	Saint Patrick's Day
Cuchulainn	Great Irish Famine	Shamrock
Drama (Irish drama)	Irish literature	Shannon, River
Druids	Irish Republican Army	Sinn Féin
Dublin, University of	Irish Sea	Tory Island
	Kerry blue terrier	Ulster

Outline

I. **Government**
- A. The president
- B. The prime minister and Cabinet
- C. Parliament
- D. Politics
- E. Courts
- F. Local government
- G. Armed forces

II. **People**
- A. Ancestry and population
- B. Language
- C. Way of life
- D. Food and drink
- E. Recreation
- F. Religion
- G. Education
- H. The arts

III. **Land and climate**
- A. Surface features
- B. Rivers and lakes
- C. Climate

IV. **Economy**
- A. Natural resources
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- C. Manufacturing
- D. Agriculture and fishing
- E. Transportation and trade
- F. Communication

V. **History**

Questions

What two bodies of water separate Ireland from the island of Great Britain?
What are Ireland's main political parties?
What organizations operate most of Ireland's schools?
Who were the Black and Tans?
How is peat used in Ireland?
What is Ireland called in the Gaelic language?
What was the *plantation of Ireland*?
Why are winters in Ireland warmer than those in New England, even though Ireland lies farther north?
Why did civil war break out in Ireland in 1922?
What was the Act of Union?

Additional resources

Connolly, Sean J., ed. *The Oxford Companion to Irish History.* Oxford, 1998.
Fodor's Ireland. Fodor's Travel, published annually.
McCormack, W. J., ed. *The Blackwell Companion to Modern Irish Culture.* Blackwell, 1999.
Pomeray, J. K. *Ireland.* Chelsea Hse., 1997. Younger readers.

Irenaeus, *ih ree NEE uhs,* **Saint** (A.D. 130?-202?), was one of the most important thinkers and leaders in the early Christian church. In his principal work, *Against Heresies,* Irenaeus attacked Gnosticism, a philosophical and religious movement that adopted pagan, Jewish, and Christian forms, and also criticized Gnostic leaders (see Gnosticism). In his book, Irenaeus asserted the authority of the Old Testament and of several writings that later became part of the New Testament. Irenaeus argued for the authority of mainstream tradition in the church. He upheld the authority of bishops to decide what is true in matters of faith as a counter to Gnostic claims to know the truth. Irenaeus also developed an important doctrine called the "recapitulation of Christ," which states that the progress of human redemption is summarized in, and sanctified by, the humanity of Jesus.

Irenaeus was born in Asia Minor. He went to Gaul (now mainly France), where he served as a priest. He was known as the peacemaker among conflicting church groups. About 177, he became bishop of Lugdunum (now Lyon, France). Stanley K. Stowers

Iridium, *ih RIHD ee uhm,* is a silvery metallic element. It is one of the hardest metals, and it resists corrosion better than any other metal. Iridium is rare. It occurs in gravel deposits containing platinum ores. It also occurs in *alloys* (metal mixtures) with osmium. Most iridium comes from Brazil, Canada, Myanmar, Russia, South Africa, and the United States. Iridium is too brittle to use by itself. Its main use is to increase platinum's strength and resistance to corrosion. Manufacturers use platinum-iridium alloys in containers, machine parts, and electric contacts that are to be exposed to corrosive chemicals and high temperatures. Jewelry and spark-plug electrodes are also made from iridium alloys.

Iridium has the chemical symbol Ir. Its atomic number is 77, and its atomic weight is 192.217. It melts at 2410 °C and boils at 4130 °C. Iridium is extremely dense. It has a density of 22.65 grams per cubic centimeter at 20 °C. Iridium belongs to the group of elements called *transition metals* (see Element, Chemical [Periodic table of the elements]). Smithson Tennant, a British chemist, discovered iridium in 1804. Emily Jane Rose

Iris, *EYE rihs,* is a popular plant with large, beautifully colored flowers. The name *iris* comes from the Greek word for *rainbow.* The unusual shape of the iris makes it easy to recognize. An iris has three sets of three petal-like parts. The lower set, called the *falls,* flares out and hangs down. The upper parts, known as *standards,* curve up into a dome. Three curved *stylebranches* cover the stamens in the center.

The colors of irises range through all shades and appear in many combinations. The plant may grow from 6 inches (15 centimeters) to more than 6 feet (2 meters) tall. The flowers vary from 1 inch (2.5 centimeters) to over 1 foot (30 centimeters) across. The leaves rise directly from *rhizomes* (underground stems). Some iris rhizomes are bulblike, but most are elongated. Iris rhizomes contain a poison. Eating them can cause severe stomach upset.

Irises grow throughout the temperate regions. These perennial plants bloom from April through July. They may be planted in spring before blooming, or in autumn. The plants with rhizomes give the best flowers if replanted about every four years. The most common garden irises are the tall bearded varieties. There are thousands of different kinds. The iris needs sun and average soil. The bearded iris also needs well-drained soil, but beardless iris does well in moist soil.

© Giuseppe Mazza
Rajah Brooke iris

The larvae of the iris borer insect eat their way through the leaves and roots, and often cause soft rot. This causes the leaves to turn yellow and the root to rot. Soft rot often follows winter injury to the

plant. When either trouble occurs, the plant should be dug up and the roots cleaned before replanting in fresh soil.

The dried rhizome of certain bearded irises is called *orrisroot.* It is used in perfumes, powders, and medicines. Iris growing has become an important specialty. The American Iris Society has promoted this work in the United States. The iris is the state flower of Tennessee.

Fleur-de-lis is a name sometimes used for the iris. It is French for *flower of the lily.* Fleur-de-lis is also the name of a design that represents the white iris. It appeared as an emblem on the scepter of Egyptian rulers in 1500 B.C., and was carved on the brow of the Sphinx. It also became the emblem of the kings of France in the 1100's. King Charles V of France adopted three golden fleurs-de-lis on a blue field as his coat of arms in the 1300's. The design is also a symbol for North on the compass.

Scientific classification. Irises make up the iris family, Iridaceae. Jerry M. Baskin

See also **Fleur-de-lis**; **Flower** (picture: Garden perennials); **Freesia**; **Orrisroot**; **Crocus**.

Irish Free State. See **Ireland** (History).

Irish language. See **Gaelic language**.

Irish literature reflects the history and spirit of the Irish people better than any other art form. This literature consists of folk tales, lyric and narrative poetry, drama, novels, and short stories. Medieval Irish literature is frequently characterized by humor, some of it sexual. This quality appears in the work of such later Irish writers as Jonathan Swift in the 1700's and James Joyce and Samuel Beckett in the 1900's.

Early Irish legends describe the brave deeds of kings, saints, and other Irish heroes. Many lyric poems written by monks during the Middle Ages show a keen observation and devout appreciation of nature. A number of plays produced in Ireland in the early 1900's express outrage at Britain's refusal to grant Irish independence.

Early Irish literature was written in the Irish, or Gaelic, language. In 1171, Norman barons from England began to seize Irish lands. The English language was introduced into Ireland about 1200 by English artisans and shopkeepers who settled on the Normans' estates. The English government seized control of Ireland in 1541. By the 1800's, the use of English had become so widespread that Gaelic almost died out. An outburst of Irish nationalism led to the revival of Gaelic during the late 1800's. But today, nearly all Irish authors write in English.

Many modern Irish authors use the vivid, earthy, everyday language of the people. But many of their works blend realism with fantasy. Exuberant description adds to the richness of the language, as do irony, puns, and satire. Yet, a melancholy, almost pessimistic mood strongly flavors much modern Irish literature.

Many critics consider the Irish writer William Butler Yeats as the greatest poet of the 1900's. Major Irish dramatists include Sean O'Casey and John Millington Synge. The Irish writers Samuel Beckett and James Joyce rank among the most experimental authors of modern times. Their imaginative styles and philosophical themes have had worldwide influence on writers.

Early Irish literature

Some Irish literature was written before the coming of Christianity in the early A.D. 400's but no examples have survived. The Irish had developed a primitive form of writing called *ogam,* which survives only in inscriptions. But early Irish culture stayed alive through oral tradition. A hereditary class of professional poets called the *filid* put the customs, history, and laws of early Ireland into verse. The verse form made these long lists of facts easier to use. Such poetry had no set rhyme or rhythm, but the repetition of similar sounds gave it a poetic quality. Wandering minstrels called *bards* composed satire and ceremonial poetry.

Missionaries and traders came to Ireland about the time of Saint Patrick, who arrived in 432. They brought with them the art of writing in the Roman alphabet, which they had learned in ancient Gaul. The Irish adopted this alphabet when they accepted Christianity.

Christianity flourished so strongly during the 400's and 500's that medieval Ireland has been called the *Island of Saints and Scholars.* Some Irish missionaries established monasteries there that became centers of learning. Other Irish priests reestablished Christian culture in western Europe after the barbarian invasions of the 400's and early 500's. As a result, Irish literature began with historical and religious writings. For example, "The Eulogy of Saint Columba" (late 500's), a poem attributed to Dallán Forgaill, praises the monk who helped bring Christianity to Scotland.

The Golden Age

Only a few examples of Irish literature written before the 600's still exist. But much that dates from about 700 to 1000 has been preserved. This includes folk tales, legends about saints, and poetry. Scholars refer to this period as the *Golden Age of Irish Literature.*

Poetry. Many early Irish manuscripts include lyric poetry written by hermits and wandering scholars. These poems express an appreciation of nature.

During the Golden Age, the filid continued to write ceremonial poetry. Some of the oldest surviving professional poems, composed about 550, praise what the filid regarded as the heroic virtue of the nobility. Other works from the period include formal laments for the dead and satires that ridicule caution or stinginess.

Heroic tales, romances, and sagas made up a major part of early Irish literature. They consist of verse set into long passages of narrative prose. These works were based on legends and were probably composed between 600 and 900. Scholars classify them into three major groups of related stories called *cycles:* (1) the mythological cycle, (2) the Ulster cycle, and (3) the Fenian cycle.

The mythological cycle, the oldest cycle, is preserved in a collection of Celtic myths called the *Lebor Gabala* (*Book of Conquests*). The cycle describes the invasion of Ireland by five supernatural races before the beginning of history. The most important of these races was the *Tuatha De Danann.* The Tuatha used their magic powers to win battles, to court lovers, and to perform superhuman feats of courage.

A richness of imagination characterizes the best mythological tales. In *The Dream of Oengus* the hero turns into a swan to win the love of a girl he met in a dream. A group of myths called the *Cycle of Saints* describes the voyages to heaven made by Christians. Some of these myths relate the adventures of pagan heroes in

paradise. Many picture heaven as an island supported by four golden pillars. In one tale, a beautiful girl beckons the hero to sail with her to heaven on a glass boat. She warns him never to return to Ireland, but he decides to visit his homeland after three days. When he sets foot on Irish soil, he turns to ashes because he has actually been away for hundreds of years.

The Ulster cycle relates the deeds of the heroes of ancient Ulster, the northeastern province of Ireland. The tales center on the court of King Conchobar, who is said to have ruled Ulster about the time of Christ. The chief character is the great hero Cuchulainn. In some ways, Cuchulainn resembles the Greek hero Achilles. But, unlike Achilles and other Greek heroes, Cuchulainn has many supernatural powers.

The best-known Ulster epic is *The Cattle Raid of Cooley,* often referred to in its Irish form as the *Táin Bó Cuailgne.* It describes the efforts of Queen Mave of Connaught to take the famous brown bull of Cooley from Ulster. Cuchulainn single-handedly fights off the invaders until the queen's army finally captures the bull. King Conchobar's army then comes to Cuchulainn's rescue and helps defeat the invaders.

The Fenian cycle contains stories about the *Fianna,* a band of mythical Irish warriors. According to legend, the Fianna roamed throughout southern Ireland about 200, led by chief Finn MacCool (see **Finn MacCool**). This cycle includes ballads, romantic tales, and sagas. *The Colloquy of the Old Men* (about 1200) is one of the most famous stories in the Fenian cycle. It describes the accidental meeting of Saint Patrick and a Fenian warrior named Caílte. Caílte entertains the saint with legends about the courageous deeds of Fenian heroes as the two men wander through the Irish countryside.

A literary decline occurred in Ireland during the Middle Ages because of a series of attacks by foreign invaders. In 795, the Vikings began to raid the eastern and southern coasts of Ireland. They destroyed monasteries and early Irish manuscripts. In the late 1100's, Normans from England seized Irish lands and destroyed many valuable texts. The filid produced ceremonial poetry until the 1600's, but their style showed more superficial polish than originality. A few poems about chivalry and courtly love also survived. The best-known work to survive from this period is an *illuminated* (decorated) manuscript known as the *Book of Kells.*

Modern works in Gaelic

After 1600, the Irish language declined in cities and towns because of the impact of English rule and because the schools forbade Gaelic. By the mid-1700's, English was the language of educated Irishmen. Good poetry continued to be written in Gaelic through the mid-1800's. Geoffrey Keating kept Irish traditions alive in his popular book *The History of Ireland,* written in Gaelic about 1634. This work encouraged a nationalistic spirit among the Irish and serves as a valuable source of knowledge about medieval Ireland.

During the 1700's, traditional Irish themes inspired some of the best Gaelic poetry ever written. Michael Comyn's *Oisin in the Land of Youth* (about 1749) derives its subject matter from Fenian legends. In her poem *The Lament for Art O'Leary* (1773), Eileen O'Leary adopted an ancient Irish mourning ritual called *keening* to express grief over her husband's murder. Brian Merriman's satirical poem *The Midnight Court* (about 1790) criticizes the reluctance of many Irish men to marry. The clever, sarcastic wit of this work rivals the satire of the famous English poet Alexander Pope.

By the mid-1800's, most Irish authors were writing in English. But in 1893, Douglas Hyde, a poet who later served as Ireland's first president, founded the Gaelic League. The league worked to reestablish Gaelic as the national language and to promote interest in Irish literature and culture. Hyde's efforts encouraged the growth of a Gaelic literary movement. Modern authors who wrote in Gaelic included Tomás Ó Criomhthain, Canon Peter O'Leary, and Patrick Pearse.

Early works in English

As early as the 1300's, a few Irish authors began to write in English. The practice of writing in English became more common as English political influence in Ireland increased. During the 1700's, Irish-born writers were producing some of the greatest masterpieces of the English language.

Jonathan Swift, though known as an English author, wrote his most important satires during the 32 years that he was dean of St. Patrick's Cathedral in Dublin. *Gulliver's Travels* (1726) ranks as his most famous work. It tells of the four voyages of a ship's doctor, later a ship's captain, to several make-believe lands. Swift used the inhabitants of these strange lands to ridicule foolish human behavior.

Drama. During the 1700's, many of the greatest Irish-born playwrights, including Oliver Goldsmith and Richard Brinsley Sheridan, won fame by writing for the English theater. Their works contain little that identifies the writers as Irish. The first plays to capture the Irish spirit were romantic melodramas written in the 1800's. Dion Boucicault became the first popular playwright to portray life from an Irish viewpoint through the use of Irish settings and characters. His plays include *The Colleen Bawn* (1860) and *The Shaughraun* (1874).

Prose and poetry. In the 1800's, Irish narrative prose began to draw on Irish themes and characters. Maria Edgeworth's *Castle Rackrent* (1800) portrays the immoral lives of Irish landlords who wasted their wealth. In *The Confessions of Henry Lorrequer* (1839), Charles Lever described the fox hunts and parties enjoyed by members of Irish high society. *Tales of the O'Hara Family* (1825-1826), by the brothers John and Michael Banim, emphasizes the Roman Catholic traditions and peasant heritage of the Irish people.

Irish poetry also began to look to the past for its roots and direction. Tom Moore, who became known as the national poet of Ireland, adopted Irish settings and subject matter in his verse. In *Irish Melodies* (1808-1834), Moore set his romantic, patriotic poems to traditional Irish folk songs. Thomas Davis, James Clarence Mangan, and other Irish poets also wrote patriotic poetry during this nationalistic era. Their poems were collected in the book *The Spirit of the Nation* (1843).

The Irish literary revival

During the late 1800's, a group of young Irish writers attempted to create a uniquely Irish literature in the English language. They wanted to draw from their own ex-

periences as Irish people and from the legends and traditions of their ancestors. The leading writers of this movement included the playwright Lady Gregory and the poet and playwright William Butler Yeats.

Yeats and Lady Gregory helped establish the Irish National Theatre Society in 1901 to encourage the writing and performance of plays about Irish life. The society's acting company became known as the Abbey Theatre Players. The Abbey Theatre became world famous and produced many of Ireland's most brilliant and controversial plays, including dramas by Sean O'Casey, John Millington Synge, and Yeats.

Many critics consider Yeats the greatest poet of his time. Yeats' writing reflects his fascination with Irish folk tales and with symbolism and the supernatural. His first major work, *The Wanderings of Oisin* (1889), is a mystical narrative poem based on the adventures of a legendary Fenian hero. Yeats wrote some of his best lyric poetry during the last 10 years of his life. Many of these works were published in *Collected Poems* (1950). He also wrote *The Countess Cathleen* (1891), one of the first plays produced by the company that later became the Abbey Theatre Players. Yeats won the Nobel Prize for literature in 1923.

John Millington Synge also wrote dramas produced by the Abbey Theatre. He was a master of what has been called "dark comedy." Synge's Irish peasant characters speak a vivid, poetic language based on Irish folk speech. His best-known works include *In the Shadow of the Glen* (1903), *Riders to the Sea* (1904), and *The Playboy of the Western World* (1907).

The greatest political upheaval in modern Ireland occurred during the period of the Irish Literary Revival. The Irish Republican Brotherhood, a secret organization that wanted an independent Irish republic, rebelled against the British on Easter Monday in 1916. Street fighting raged in Dublin for a week before British forces put down the uprising. By 1919, the rebels were regularly attacking British Army installations and government buildings. Finally, in 1921, the British allowed southern Ireland to become a *dominion* (self-governing country) called the Irish Free State. But many Irish people demanded total independence from Britain, and civil war broke out in 1922.

Several Irish authors wrote about the guerrilla warfare that raged in their homeland. For example, Sean O'Casey created vivid, realistic dramas that take place around the time of the Easter Rebellion and the Irish Civil War. The Abbey Theatre produced two of his early tragicomedies, *The Shadow of a Gunman* (1923) and *Juno and the Paycock* (1924). But riots broke out during performances of one of his best works, *The Plough and the Stars* (1926). Many people believed that the play's antiwar theme insulted the heroes of the Irish rebellion and slandered Irish womanhood. O'Casey's best-known works also include *Purple Dust* (1940) and *Red Roses for Me* (1942). Some of his later plays call for a radical transformation of society through socialism to improve the lives of the poor.

Modern Irish literature

James Joyce was one of the most influential writers of the 1900's. Like many other Irish authors, Joyce lived outside Ireland. He believed that Ireland's strict nationalistic and religious attitudes prevented writers from portraying Irish life realistically. But his works reflect the Irish experience and contribute to Ireland's national literature.

Joyce revolutionized the structure and literary style of the novel. His first major work, a short-story collection called *Dubliners* (1914), offers a realistic picture of life among the Irish lower-middle class. In his autobiographical novel *A Portrait of the Artist as a Young Man* (1916), Joyce at times used an experimental style called *stream of consciousness*. This technique involves recording the characters' thoughts exactly as they occur, without comment by the author. Joyce proved his mastery of this complex style in *Ulysses* (1922). In this novel, he drew parallels between the adventures of an Irish advertising salesman and the wanderings of Ulysses in Homer's epic poem, the *Odyssey*. *Finnegans Wake* (1939) explores the dreams, fears, and secret thoughts of a Dublin innkeeper and his family. Joyce attempted to link their experiences to all humanity through a complex pattern of symbols. He drew these symbols from Irish history, literature, songs, slang, and other sources.

Drama. Throughout the early 1900's, the Abbey Theatre performed plays written by gifted Irish dramatists. For example, Padraic Colum wrote several realistic dramas about country life that were produced by the company. His works include *The Fiddler's House* (1907) and *Thomas Muskerry* (1910). Lord Dunsany became known for one-act dramas, such as *A Night at an Inn* (1916), that deal with fantasy and the supernatural. Paul Vincent Carroll wrote commentaries on Irish society, including *Shadow and Substance* (1937).

George Bernard Shaw and Oscar Wilde, two famous Irish-born playwrights, gained their reputation with witty comedies for the English theater. Shaw revealed his strong ties to his homeland in *John Bull's Other Island* (1904). He wrote this satire on Anglo-Irish relations for the Irish National Theatre Society.

The Irish writers who won international fame during the mid-1900's became known for their plays. Samuel Beckett, a close friend of James Joyce, wrote fiction and plays that show people as helpless, pathetic creatures whose lives have no meaning. Beckett wrote many works in French and translated them into English in an effort to strip his nationality and style from his writing. He won the 1969 Nobel Prize for literature.

Political themes dominated much Irish drama during the 1950's and 1960's. Brendan Behan, a colorful personality, served several prison terms for his anti-British activities as a member of the Irish Republican Army (IRA). His two best plays, *The Quare Fellow* (1954) and *The Hostage* (1958), reflect his rebellious spirit and strong social conscience. Brian Friel became a major voice in Irish drama with *Philadelphia, Here I Come!* (1964), about a young Irishman leaving his family to emigrate to the United States. Thomas Kilroy wrote about the breakdown of community, the isolation of the individual, and the futility of political rebellion in *The Death and Resurrection of Mr. Roche* (1968).

Fiction and poetry. Modern Irish drama has received more worldwide attention than any other type of Irish literature. But Irish authors produced some of the best novels, poetry, and short stories of the 1900's.

James Stephens combined Irish folk themes with

scenes from everyday life in his imaginative fiction and poetry. His fantasy novel *The Crock of Gold* (1912) ranks as his best-known work. Liam O'Flaherty's psychological novels, such as *The Informer* (1925), explore the attitudes of poor Irish farmers and city dwellers in a lyrical but realistic style. Frank O'Connor's collection *Guests of the Nation* (1931) portrays Irish rural life. Flann O'Brien (the pen name of Brian O'Nolan) wrote satirical novels about Irish life, including *At Swim-Two-Birds* (1939). Sean O'Faolain explored the reactions of everyday Irish people to personal crises, to the Catholic clergy, and to political struggles. He wrote novels and short stories, including the collection *The Man Who Invented Sin* (1948).

Irish poets of the mid-1900's also drew material from uniquely Irish sources. Patrick Kavanagh created lyrical poetry in a simple, straightforward style. His famous poem *The Great Hunger* (1942) deals with poor Irish farmers. Austin Clarke satirized social and religious hypocrisy in such collections as *Ancient Lights* (1955).

Important fiction writers of the late 1900's and early 2000's included John McGahern, Benedict Kiely, Brian Moore, Roddy Doyle, and William Trevor. McGahern's first novel, *The Barracks* (1963), is a sensitive story of Irish village life. Kiely dealt with the conflict between northern and southern Ireland in *Nothing Happens in Carmincross* (1985). Moore explored the same theme in *Lies of Silence* (1990). Doyle wrote about the violent history of Ireland in the early 1900's in *A Star Called Henry* (1999). Trevor's quietly realistic short stories appeared in his collection *The News from Ireland* (1986).

Perhaps the two major Irish poets were Thomas Kinsella in the south and Seamus Heaney in the north. Kinsella's poems appear in such volumes as *Notes from the Land of the Dead* (1973) and *Collected Poems 1956-1994* (1996). Heaney's books included *North* (1975), *Seeing Things* (1991), and *The Spirit Level* (1996). He took part in the Field Day Project, a theater and publishing company founded in 1980 by playwright Brian Friel and actor Stephen Rea to promote interest in Irish literature. Women poets, including Eavan Boland, Eiléan Ní Chuilleanáin, Nuala Ní Dhomhnaill, Medbh McGuckian, and Paula Meehan, gained new prominence in the 1990's and 2000's. Lorraine Weir

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Finn MacCool	O'Flaherty, Liam	

Additional resources

Cahalan, James M. *Modern Irish Literature.* G. K. Hall, 1993.
Welch, Robert, ed. *The Oxford Companion to Irish Literature.* Clarendon Pr., 1996.

Irish moss, also called *carrageen, KAR uh GEEN,* is the name of several kinds of seaweeds that grow along rocky shores and are collected for commercial use. Irish moss is a marine alga, not a true moss. The most common Irish moss is dark red or purple-red and has forked, fan-shaped branches. Most Irish moss is harvested in Ireland and France and on the eastern coasts of the United States and Canada. Irish moss is used in chocolate milk, ice cream, toothpaste, cough syrup, shoe polish, and other products. Valrie A. Gerard

Scientific classification. Irish moss belongs to the family Gigartinaceae. The scientific name for the most common commercial species is *Chondrus crispus.*

See also Algae; Seaweed.

Irish Republican Army (IRA) is a military organization that has long sought to unite the independent country of Ireland with Northern Ireland, a part of the United Kingdom. The IRA's political wing is called *Sinn Féin.*

Beginnings. The IRA was formed in 1919 as an unofficial military force that aimed to gain independence for Ireland. At that time, present-day Ireland and Northern Ireland made up a single country ruled by the British. Most of the people in what is now Northern Ireland were Protestants, and most of those in what is now Ireland were Roman Catholics. The British government had proposed that Ireland remain united with the United Kingdom but take control of its own domestic affairs. However, most of the Protestants in the northeastern province of Ulster opposed this plan because they did not want to be a minority in a Roman Catholic nation.

In 1919, the IRA began a guerrilla war for independence from British rule. The IRA harassed the police and military with ambushes and sudden raids. In 1920, the British government passed the Government of Ireland Act. The act divided Ireland into two states, each with limited powers of self-government. Under the act, the six northeastern counties were separated from the rest of Ireland and became Northern Ireland. The southern Catholic majority rejected the act and demanded a single, united Irish republic. The guerrilla war continued until July 1921, when British and Irish leaders declared a truce and agreed to the Anglo-Irish Treaty. This treaty, which was signed on Dec. 6, 1921, made southern Ireland a *dominion*—that is, a self-governing country owing allegiance to the British Crown. The dominion was called the Irish Free State.

Division in the IRA. The Anglo-Irish Treaty split the IRA. One group, led by Michael Collins, accepted the treaty and became part of the army of the Irish Free State. The other group, led by Eamon de Valera and called the Irregulars, rejected the treaty because it did not provide complete independence from the United Kingdom and union with Northern Ireland. Early in 1922, civil war broke out. The Irregulars were defeated in 1923 but continued as an underground organization.

In 1937, the Irish Free State adopted a new constitution and changed its name to Eire. In 1949, Eire renounced its dominion status and declared itself an independent republic called Ireland. Northern Ireland remained in the United Kingdom. From 1956 to 1962, the IRA periodically raided British installations in Northern Ireland, trying to reunite Ireland and Northern Ireland and embarrass both the British and Irish governments.

In the late 1960's, Catholics in Northern Ireland began to protest discrimination by the Protestant government. Fighting broke out between Catholics and Protestants, and the IRA took up the cause of the Catholics. The United Kingdom sent troops to restore order, and the IRA and British soldiers were soon fighting each other.

Violence and peace. During 1969 and 1970, a deep split occured within the IRA over strategy and tactics.

One group, known as the Official IRA, consisted of older members committed chiefly to nonviolent action. The dominant group, called the Provisional IRA, adopted terrorist tactics to achieve their goals. They carried out many bombings, ambushes, and assassinations in Ireland and the United Kingdom. But decades of violence did not change the status of Northern Ireland.

Peace agreement. In July 1997, the IRA declared a cease-fire. In September of that year, peace talks on Northern Ireland began in which all parties were represented, including Sinn Féin. The talks concluded in an agreement that committed the parties to using peaceful means to resolve political differences. A small group calling itself the Real IRA split from the Provisional IRA. The Real IRA opposed the peace agreement and continued violent attacks. The rest of the IRA began to disarm in 2001. For more information on the peace agreement, see Northern Ireland (Recent developments).

L. Perry Curtis, Jr.

See also **Ireland** (History); **Northern Ireland** (History); **Sinn Féin.**

Irish Sea is a body of water between Ireland on the west and England and Wales on the east. It opens to the Atlantic Ocean through the North Channel on the north and St. George's Channel on the south. The wide St. George's Channel, which is south of Dublin, is often considered part of the Irish Sea.

The sea is about 140 miles (225 kilometers) wide at its widest point. It measures about 85 miles (140 kilometers) long excluding St. George's Channel and 190 miles (306 kilometers) long including the channel. A relatively shallow sea, it is less than 300 feet (90 meters) deep in most places. The sea has two large islands. They are the Isle of Man, in the north-central section; and Anglesey, off the coast of Wales. Two bridges join Anglesey to the mainland. Dublin, Ireland; and Liverpool, England, rank as the chief ports on the Irish Sea. Desmond A. Gillmor

Irish setter is an attractive dog with a brownish-red coat. The coat may be solid red, or red with white markings on the forehead, chest, and feet. Solid red Irish setters are the most common. In the United States and Canada, the solid red coat is preferred for show dogs. In Ireland, where the breed originated, there is no favorite coloring for show dogs. Irish setters stand between 25 and 27 inches (64 and 69 centimeters) high at the shoulder and weigh from 60 to 70 pounds (27 to 32 kilograms). Basically a hunting dog, the Irish setter is also popular as a pet.

Critically reviewed by the American Kennel Club

See also **Dog** (picture: Sporting dogs); **Setter.**

WORLD BOOK photo by Ken Love

The Irish setter has a shaggy, brownish-red coat.

Irish terrier is a medium-sized dog that originated in Ireland during the 1700's. In Ireland, the dog was used for hunting rats and for fetching game that had been shot. Many Irish terriers were used to carry messages on battlefields in World War I (1914-1918) and World War II (1939-1945). Today, the dog is kept mainly as a pet. It has a long, narrow head, a short beard, and a wiry red coat. It carries its tail straight up. Most Irish terriers weigh from 25 to 27 pounds (11 to 12 kilograms).

Critically reviewed by the American Kennel Club

See also **Dog** (picture: Terriers); **Terrier.**

Irish water spaniel is sometimes called the clown of the dog family. Its coat of short brownish-red curls and the tuft of curls on its head make it look like a clown. Its tail is thin, tapering, and almost hairless. The Irish water spaniel is valuable as a hunting dog on land and in the water. It is considered one of the best duck retrievers. The dog stands 21 to 24 inches (53 to 61 centimeters) high at the shoulder, and weighs from 45 to 65 pounds (20 to 29 kilograms). See also **Dog** (picture: Sporting dogs); **Spaniel.** Critically reviewed by the American Kennel Club

Irish wolfhound is the tallest of all dogs. It stands about 32 to 34 inches (81 to 86 centimeters) high and weighs from 126 to 145 pounds (57 to 66 kilograms). The Irish wolfhound is powerful and swift, yet it is also known for its gentleness. The dog's rough, wiry coat may be gray, brindle, red, black, white, or fawn. The Irish wolfhound originally was bred in Ireland in the 400's for hunting wolves and deer.

Critically reviewed by the Irish Wolfhound Club of America

See also **Dog** (picture: Hounds); **Hound.**

Iritis, *eye RY tihs,* is an inflammation of the iris, the colored part of the eyeball. The iris, a delicate membrane, determines the amount of light that passes through the pupil. Iritis can result from a variety of causes, including injury to the eyeball. It also may be associated with such diseases as chickenpox, mumps, rheumatoid arthritis, or tuberculosis. Iritis may occur by itself but may also accompany inflammation of other eye parts.

Symptoms of iritis include a throbbing ache in the eyeball, *photophobia* (extreme sensitivity to light), a flow of tears, decreased vision, a red eyeball, and a small pupil. The physician often gives the patient anti-inflammatory drugs and drugs that paralyze the muscles in the iris. Paralysis of these muscles puts the iris at rest and decreases the pain and photophobia. If the disease causing the iritis can be identified, the doctor treats that disease in most cases. Ronald Klein

Irkutsk, *ihr KOOTSK* (pop. 592,400), is a manufacturing, transportation, and cultural center in Russia. The city lies in southern Siberia on the Angara River, just west of Lake Baikal (see **Russia** [political map]).

Economic activities of Irkutsk include engineering, and the production of clothing, construction materials, and food and wood products. Irkutsk has a university and a number of other institutes of higher learning.

Irkutsk was founded in the mid-1600's as a military

outpost and a wintering station for fur trappers and traders. The Trans-Siberian Railroad reached Irkutsk in 1898 and stimulated its growth. Leslie Dienes

Iron is a silvery-white metal in its pure state. All plants, animals, and human beings need iron in their bodies. Iron also is important because it is the basic material for many manufactured things. This metal seldom occurs in a pure state. It is obtained from certain kinds of rock, or ore (see **Iron and steel** [Sources of iron ore]).

Properties. Iron can be identified by its physical qualities, or *properties.* It can be hammered into thin sheets or drawn out into fine wires. Iron is easily magnetized. It unites easily with nonmetals, such as sulfur, oxygen, and carbon. Iron unites easily with oxygen to form *iron oxide,* which we know as iron rust (see **Oxidation; Rust**). Iron may be *alloyed* (combined) with other metals. It is made into steel by adding a small amount of carbon (see **Iron and steel** [How steel is made]).

The chemical symbol for iron is *Fe,* which comes from the Latin word *ferrum,* meaning *iron.* Iron has an atomic number of 26, and an atomic weight of 55.85. At 20 °C, it has a density of 7.874 grams per cubic centimeter (see **Density**). Scientists also have set up a table to classify the hardness of minerals. In the hardness scale, iron is in Group V. This means the metal can be cut with a sharp knife, but only with great difficulty. Iron melts at 1535 °C and boils at 3000 °C. It dissolves in water, but the process takes a long time.

How bodies use iron. General combinations of iron and protein are found in different parts of the body. Iron appears in the organs of the body where blood cells are formed and destroyed. Small amounts of iron are necessary in all cells of the body for their proper functioning. Iron is also needed in muscles and other tissues.

In most adult males, the total amount of iron in the body averages about $\frac{1}{8}$ ounce (3.5 grams). About 65 percent of this iron is found in red blood cells, where it forms an essential part of a substance called *hemoglobin.* Hemoglobin carries oxygen from the lungs to other tissues of the body. It also carries carbon dioxide away from tissues to the lungs, which expel the carbon dioxide. Red blood cells live about 120 days. About 1 percent of all red blood cell iron is released daily from dead red cells. Almost all of the iron from dead red blood cells can be reused by the body. Daily loss of iron in a typical adult male is extremely small and principally results from the shedding of dead skin and from sweating. Iron loss is much higher in menstruating females and any other time that the body loses blood.

When a person's daily diet does not provide a new supply of iron, eventually hemoglobin cannot be made. Over a period of time, the lack of sufficient iron will result in *iron-deficiency anemia,* a condition characterized by tiredness and weakness. About 0.1 percent of the body iron is in the blood plasma. This iron is bound to a protein called *transferrin* that transports it to cells or to the organs where the iron is stored. About 10 percent of the total body iron is in the muscles in the form of *myoglobin.* Myoglobin is slightly different in composition from hemoglobin, but its function is similar. It transports and stores oxygen for use during muscle contraction. See **Blood; Hemoglobin**.

The chief storage houses for iron in the body are the liver, the spleen, and bone marrow. These tissues store the iron that people and animals take into their bodies in the food they eat. Animal liver is the richest source of food iron. Foods of animal origin, particularly red meats, generally supply greater amounts of iron to the diet than do foods of plant origin. Exceptions are milk and dairy products, which are poor sources of dietary iron. After severe blood loss and during infancy, childhood, and pregnancy, the demands for iron are high, and the reserve supply may become low. In these situations, the diet must supply greater amounts of iron to the body.

In addition to carrying oxygen, iron also plays a part in the use of oxygen by tissues. Tissues use iron as part of enzymes to form a wide variety of essential bodily compounds. In plants, iron plays an important part in the formation of chlorophyll.

How iron is used in medicine. Hundreds of years ago, the Hindus in India prepared a medicine known as Lauha Bhasma. They roasted sheets of iron, and then ground them into a fine white powder in oil or milk. This medicine was their treatment for anemia.

In 1831, scientists learned that too small an iron content in the diet caused a faulty formation of blood. Using iron scientifically to treat anemia began at that time. Since then, doctors have obtained added knowledge about the nature of the blood. But the only important use of iron in modern medicine is in the prevention and treatment of iron-deficiency anemias. See **Anemia**.

A great many preparations of iron are available in medicine. Most of these preparations are iron salts. Physicians prescribe iron compounds for treatment of iron-deficiency anemia and to prevent its occurrence during pregnancy and infancy. Most often these compounds are salts and are given in the form of pills or drops. Poisoning from medicines containing iron sometimes occurs among infants and children. Mary Frances Picciano

Iron Age is the period of history that began between 1500 and 1000 B.C. with the widespread use of iron for tools and weapons. This age continues to present day.

By about 3500 B.C., some peoples in the Middle East had begun to smelt iron ore and use the iron for tools. They decorated many of these skillfully made tools. The oldest pieces in existence are Egyptian sickle blades and a crosscut saw thousands of years old. But during the Bronze Age, most craftworkers continued to use the primitive tools of the late Stone Age because metal was expensive. Only kings and warriors could afford it.

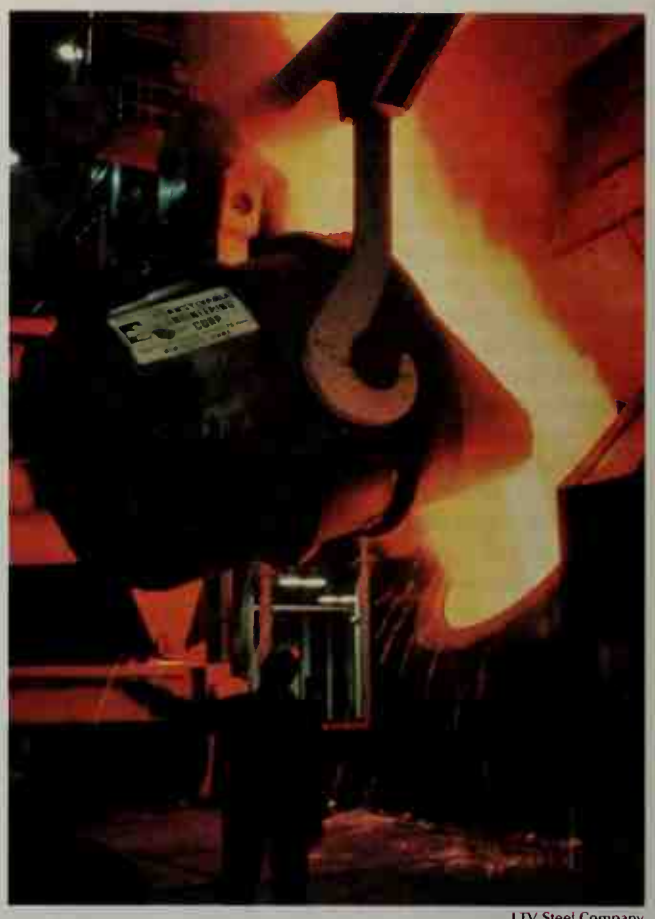
True iron working began in Asia Minor (now part of Turkey) between 1500 and 1000 B.C. and spread over much of Asia, Africa, and Europe. The great advantage of iron was its cheapness, because iron ore is abundant and widespread. In the Iron Age, carpenters and masons abandoned the crude tools of the Bronze Age. Craftworkers could then afford metal tools, and made wide use of iron, including iron plows.

Southern Europe learned the use of iron long before the northern countries did. The Greek poet Homer speaks of iron as something precious, like gold. But the people of Scandinavia knew little about iron before the time of Julius Caesar. During the Iron Age, many inventions, such as the alphabet, came into general use. People also began to use coins. Improved trade, transportation, and communication helped civilization expand and progress. Brian M. Fagan

See also **Bronze Age; Iron and steel** (The Iron Age).

WORLD BOOK photo

From iron ore to steel. Steelmakers work with many forms of iron and steel. For example, they convert pellets of concentrated ore into pig iron, which is refined into steel.



LTV Steel Company

Pouring molten iron into a steelmaking furnace is one of the many spectacular sights in a steel mill. The temperature of the liquid metal is about 2800 °F (1500 °C).

Iron and steel

Iron and steel are the world's cheapest and most useful metals. These hard, durable metals are used in making thousands of products, from paper clips to automobiles. Machines made of iron and steel help produce almost everything we use, including our clothes, our homes, and even our food.

The word *iron* can refer to both an element and a number of *alloys* (mixtures) of iron and other metallic elements. As an element, iron is one of the most common chemical substances in the earth's crust, but it is never found in pure form there. Almost all iron occurs in ores, though some meteorites also contain iron. Manufacturers use iron alloys in the manufacture of so-called iron products.

Steel is produced by *refining* (purifying) iron and alloying it with other metals. Iron may be thought of as the basic material of steel, and steel may be considered the refined product of iron. Similarly, gasoline can be thought of as refined oil. However, the *properties* (characteristics) and uses of iron and steel differ as widely as do those of gasoline and oil.

Iron ores are mineral or rock deposits in which iron was concentrated by natural forces during the formation of the earth's crust. Steel manufacturers crush and process these ores to produce high-grade iron concentrates. The concentrates are turned into metallic iron by heating them with other raw materials in huge furnaces. Most metallic iron is used in manufacturing steel, but some is made into iron products. Steelmakers convert metallic iron into liquid steel by refining it in furnaces with recycled iron and steel scrap. The liquid steel is then formed into sheets, beams, rods, wire, tubing, and other shapes used in making various products. Most modern steel mills perform all the steps in steelmaking, from smelting iron ore to producing steel in useful shapes and forms.

As early as 4000 B.C., people used iron from meteorites to make ornaments, weapons, tools, and utensils. However, no one knows when or where people first made iron from iron ore. This process developed independently in several parts of the world, including the Middle East, China, and India. It spread quickly to other regions. By about 1000 B.C., most advanced civilizations had mastered the art of ironmaking. Early ironmakers produced small quantities of tough, elementary forms of steel. However, steel could not be manufactured cheaply in large quantities until the late 1800's. The technology of steelmaking developed most rapidly during the second half of the 1900's.

Today, the production of iron and steel is one of the world's most vital industries. Throughout the world, mil-

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Milt and Joan Mann

Casting steel into a solid form is the first step in shaping it into useful products. Modern casting equipment produces continuous strands of solid steel like the one shown above.

lions of workers are employed in steel-manufacturing plants. Millions of additional workers provide machinery, raw materials, and energy to iron and steel companies or manufacture consumer products from iron and steel.

Kinds of iron and steel

The metals called iron and steel are alloys of the element iron. In general, steel is any alloy of the elements iron and carbon that contains less than 2 per cent carbon. Almost all types of steel also contain some manganese, and many kinds also include other elements. The properties of any kind of iron or steel depend largely on the chemical composition of the alloy. Heating and *working* (shaping) the metal can greatly change its physical properties.

There are thousands of kinds of iron and steel. But all types of iron can be classified as (1) pig iron, (2) cast iron, or (3) wrought iron. All kinds of steel can be grouped as (1) carbon steel, (2) alloy steel, (3) stainless steel, or (4) tool steel.

Pig iron is iron produced in a blast furnace. Most pig iron contains about 93 per cent iron, 3 to 4 per cent carbon, and smaller amounts of other elements. The term *pig iron* comes from an early method of pouring liquid iron from a blast furnace into molds set around a central channel. The molds looked somewhat like a group of baby pigs around their mother. The bars of iron that formed in the molds were called *pigs*. Today, most pig iron is used in making steel, rather than being cast into pigs. However, a small amount is made into cast iron or wrought iron.

Cast iron is any iron alloy that contains from 2 to 4 per cent carbon and from 1 to 3 per cent silicon. Because of its high carbon content, solid cast iron cannot be shaped, no matter how hot it is heated. This kind of iron is made into useful objects by pouring the liquid metal into molds and letting it harden. Cast iron's hardness, low cost, and ability to absorb shocks make it an important construction material.

Wrought iron is nearly pure iron mixed with a glass-like material. Unlike cast iron, wrought iron is *malleable* —that is, it can be hammered into various shapes. Wrought iron also resists *corrosion* (rust) better than cast iron does.

Wrought iron was once used in making many products now made from steel. Today, steel companies produce only small amounts of wrought iron. Most of it is made into porch railings and other decorative items.

Carbon steel is by far the most widely used kind of steel. The properties of carbon steel depend primarily on the amount of carbon it contains. Most carbon steel has a carbon content of less than 1 per cent. Carbon steel is made into a wide range of products, including structural beams, automobile bodies, kitchen appliances, and cans.

Alloy steel contains some carbon, but its properties result chiefly from the addition of other chemical elements. Each added element improves one or more of the steel's properties. For example, manganese increases hardness, toughness, and resistance to wear. Nickel provides greater toughness, especially in steels used at extremely low temperatures. Molybdenum increases hardness and resistance to corrosion, and tungsten makes steel resistant to heat. Other elements used in alloy steel include aluminum, chromium, copper, silicon, titanium, and vanadium.

Stainless steel resists corrosion better than any other type of steel. Chromium is its chief alloying element. All stainless steel contains at least 12 per cent chromium, and some has a chromium content as high as 30 per cent. Many stainless steels also contain nickel. Such household items as knives, flatware, and pots and pans are made of stainless steel. Various kinds of stainless steel are used in a large number of products, including automobile parts, hospital equipment, and razor blades.

Tool steel is extremely hard steel used in metalworking tools. Tool steels are produced by *tempering* certain types of carbon steel and alloy steel. In the tempering process, steel is heated to a high temperature and then cooled quickly.

Sources of iron ore

The term *iron ore* commonly refers to any rock or mineral that contains enough iron to make it possibly worth mining. The location and characteristics of an ore deposit may at first make it undesirable as a source of iron. However, improvements in transportation, mining techniques, or mineral processing may later make a deposit commercially valuable. Increased demand for iron, or changes in government policies or world trade, can also lead to the opening of new mines.

The supply of iron ore in the world remains plentiful even though the steel industry continually uses huge amounts of it. In the United States and some other countries, much of the richest ore has been used up. As a result, steel companies have developed manufacturing techniques that enable them to use lower-grade ores. The United States also imports iron ore from Canada and various other nations.

Kinds of iron ore. In nature, iron always occurs in chemical combination with other elements, especially oxygen, carbon, sulfur, and silicon. The many kinds of iron ores thus contain chemical compounds made up of iron and one or more other elements. The principal ores from which iron is obtained include *hematite, magnetite, limonite, pyrite, siderite,* and *taconite.*

Hematite and magnetite are the richest iron ores. They are *iron oxides* (compounds of iron and oxygen) and contain about 70 percent iron. Hematite may occur as shiny crystals; grainy rocks; or a loose, earthy material. It may be black, brownish-red, or dark red. Magnetite is black and has magnetic properties.

Limonite has an iron content of about 60 percent. It is yellow-brown and consists of iron oxide and water.

Pyrite is about half iron and half sulfur. It has a shiny, metallic appearance and looks like gold.

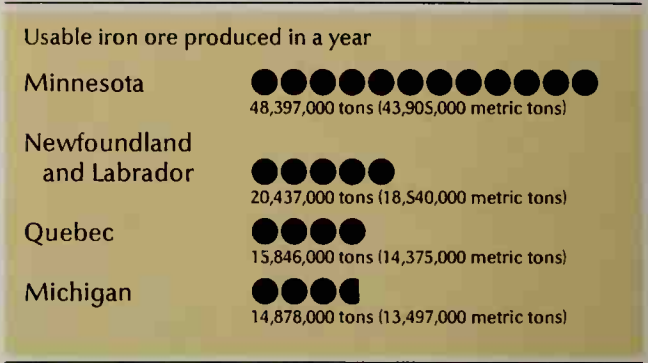
Siderite is a gray-brown compound that contains about 50 percent iron, plus carbon and oxygen. In the past, it served as an important source of iron in the United Kingdom and Germany. However, those two nations have largely used up their deposits of siderite.

Taconite is a hard rock that contains about 30 percent iron. The iron occurs in the form of fine specks of magnetite or, in some cases, hematite. Taconite has increased in importance as deposits of richer iron ores have been used up.

Leading iron ore mining countries

Figures are for 1999.
Source: U.S. Geological Survey

Leading iron ore mining states and provinces



Figures are for 1999.
Sources: U.S. Geological Survey; Natural Resources Canada.

Iron ore deposits. The world's largest deposits of iron ores were formed by a process that began more than 2 billion years ago. This process took place in areas then covered by shallow seas. Iron compounds in the water gradually settled to the bottom of the seas. There, together with sand and a fine-grained material called *silt,* the iron compounds were formed into rock. Earthquakes and the shrinking of the earth's crust later raised this rock above the level of the water. In some areas, extremely rich concentrations of ore were left behind as water trickled through the rock, dissolving much of the sand.

Other iron ore deposits were formed in different ways. For example, the slow cooling of molten volcanic rock produced iron ore deposits in Sweden and some other areas. Elsewhere, tiny organisms in the water caused iron oxide to form. Today, iron oxides accumulate in marshy areas and on beaches.

The most important iron ore deposits in the United States lie near Lake Superior in Minnesota and Michigan. The Mesabi Range in Minnesota has produced more ore than any other area in the nation. California, Missouri, and Wyoming also have major deposits of iron ore. Canada's chief deposits occur along the border between the province of Quebec and the province of Newfoundland and Labrador and north of Lake Superior in Ontario. Other nations that have large deposits of iron ore include Australia, Brazil, China, India, Russia, and Ukraine. One of the world's richest deposits is Cerro Bolívar, a mountain of iron ore in Venezuela.

Mining and processing iron ore

There are two basic methods of mining iron ore, *open-pit mining* and *underground mining.* After the ore has been removed from the earth, it must be processed to make it suitable for use in making iron.

Open-pit mining is used to dig out deposits of iron ore that lie near the surface of the earth. First, bulldozers and other earthmoving equipment remove the soil and rocks that cover the deposits. This material is called the *overburden.* Next, miners use explosives to break up the mass of ore. Huge power shovels then scoop the ore into trucks and railroad cars for delivery to a central processing station.

Most of the world's iron ore comes from open-pit mines. These mines provide about 96 percent of the supply produced in the United States. The largest open-pit mines extend over several square miles or square kil-

G. Lucas, Atoz Images

Open-pit mines, such as this one in southern Ontario in Canada, produce most of the world's iron ore. Open-pit mining is used to mine deposits of ore that lie near the surface of the earth.

ometers and may measure more than 500 feet (152 meters) deep.

Underground mining, also known as *shaft mining,* involves digging tunnels into an ore deposit. Miners then go into the tunnels to remove the ore. To mine iron ore far below the surface, they dig a shaft into the rock next to the deposit. From this shaft, the miners drill horizontal tunnels into the ore at various levels. Conveyor belts or special railroad cars transport the ore to the shaft, where it is hoisted to the surface in buckets.

Underground mining is much more expensive and hazardous than open-pit mining. Today, this method is rarely used except to mine extremely high-grade ore and ore that lies near a steelmaking center. Miners also go underground to remove iron ore from inside a mountain. They reach such deposits by drilling horizontal tunnels into the side of the mountain. This method of underground mining brings much iron ore from the mountains of western Australia.

Processing. Ores with a high iron content may need only to be crushed, screened, and washed to remove particles too small for use. However, the United States and most other nations rely heavily on the use of taconite and other ores that require much processing. These ores must be broken down so that the particles of rich ore can be separated from worthless sand and rock. The rich ore is called *concentrate,* and the waste materials are referred to as *tailings.*

The Hanna Mining Company

Processing iron ore prepares it for use in making iron. Low-grade ore called *taconite* is crushed to a fine powder by steel rods or balls in rotating barrels, *left.* Particles of iron oxide from the powder are moistened and combined with clay in rotating drums to form small pellets, *right.*

Taconite must be crushed and ground to free the crystals of iron oxide from the surrounding material. Chunks of taconite are crushed to fine powder by tumbling them with steel rods or balls in large, rotating barrels. Powerful magnets then remove particles of magnetite from the powder. If the taconite contains hematite, which is not magnetic, workers must put the crushed ore into a chamber containing a mixture of liquids. The waste particles remain suspended in the liquid. But the particles that contain iron are denser and so settle to the bottom. This concentrated iron oxide is then removed from the chamber and dried.

Iron oxide produced from taconite must be converted into a form suitable for shipping and for use in making iron. In the most widely used process, the concentrate is moistened and combined with clay in rotating drums to form small pellets. The pellets, which measure $\frac{1}{2}$ inch to 1 inch (1.25 to 2.5 centimeters) in diameter, are dried and baked to a hard finish.

Taconite produces about 2 short tons (1.8 metric tons) of tailings for every 1 short ton (0.9 metric ton) of iron-oxide pellets. Therefore, iron ore is processed near the mine to save the cost of transporting huge quantities of waste material. Most of the pellets made in the United States come from the Lake Superior area. They are transported by ship to iron and steel plants on the southern shores of the Great Lakes.

In the past, processors dumped the tailings into Lake Superior. However, a federal court ordered an end to this dumping because it was creating pollution in the lake. Processors now dispose of such tailings in large artificial basins.

How iron is made

To convert iron ore into metallic iron, ironmakers must remove the oxygen from the ore. This process requires heat and a *reducing agent,* a substance that combines with the oxygen that is released.

Iron is made in either a *blast furnace* or a *direct reduction system.* In a blast furnace, iron ore is combined with a reducing agent at high temperatures to produce liquid iron. In a direct reduction system, the temperature remains below the melting point of iron.

The newest methods of ironmaking and steelmaking feature a continuous flow of material and extensive automation that make production cheaper and more efficient. Most plants in the United States are relatively old, however, and still use the traditional methods described in this article.

Raw materials. Ironmaking involves a variety of raw materials in addition to iron ore. The most important one is the reducing agent. A direct reduction system uses coal or natural gas as a reducing agent. In a blast furnace, *coke* serves as the reducing agent. Coke is a hard substance that consists of about 90 percent carbon. It is made by heating coal in airtight ovens. Heat drives out gases and tar from the coal, and coke remains.

Limestone is another important raw material in the blast furnace process. It helps remove impurities from iron ore. Many of these impurities do not usually melt at

How a blast furnace operates

Iron is made in a blast furnace by means of chemical reactions among iron ore, coke, limestone, and a blast of heated air. Cars carry the *charge* (solid materials) up a ramp and dump them into the furnace. Air is heated in giant stoves and blown into the lower part of the furnace. Liquid iron also settles to the bottom of the furnace and is tapped into a *hot-metal car.* The limestone combines with impurities and forms *slag* (waste), which flows into a *slag ladle.*

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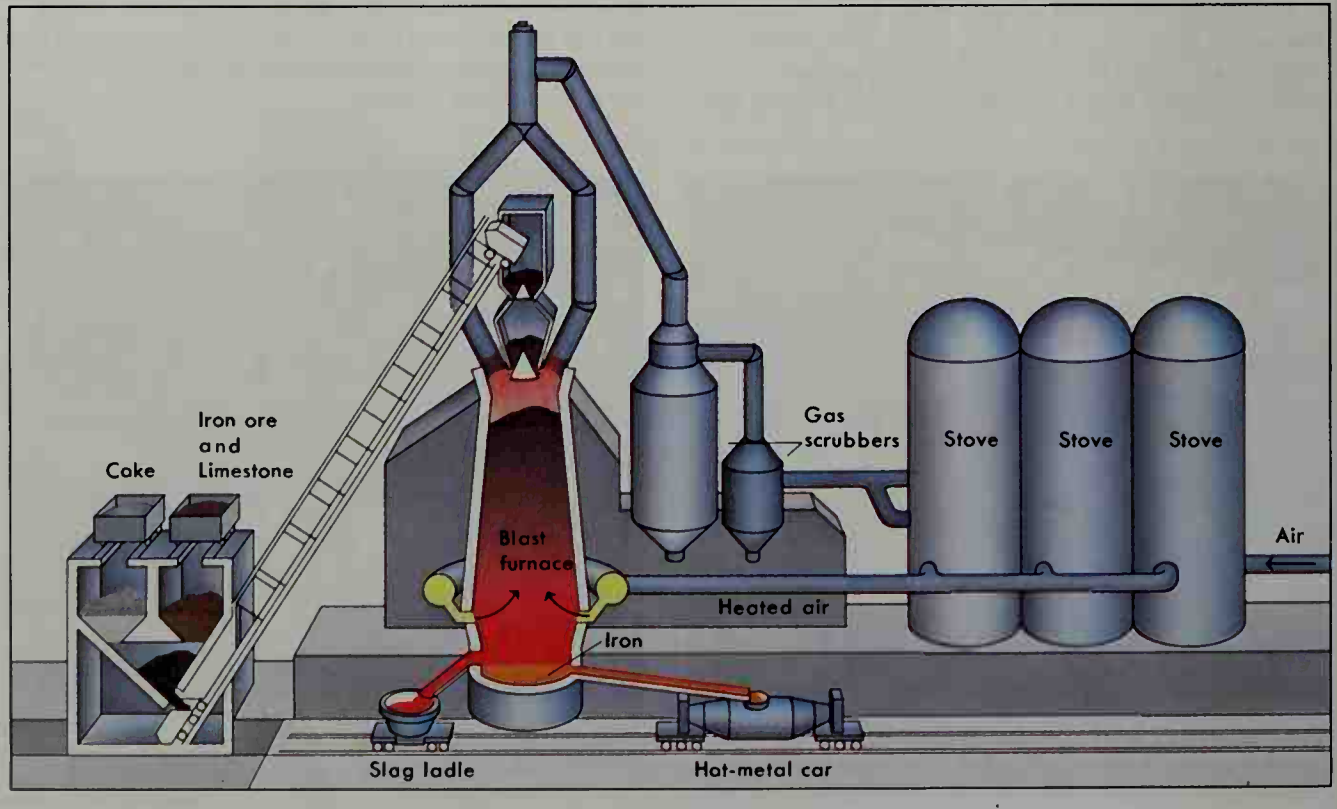


temperatures as low as the melting point of iron. But limestone, when mixed with iron ore, acts as a *flux*—that is, it combines with impurities in the ore and causes them to melt at lower temperatures. The impurities that float to the top of the melted iron are called *slag*.

A blast furnace also uses huge amounts of air and water. Air makes the coke burn. Water cools the furnace and cleans waste gases produced during ironmaking.

Running a blast furnace. A blast furnace is a huge cylinder made of steel and lined with *firebrick* (heat-resistant brick). Some blast furnaces stand more than 100 feet (30 meters) tall and measure over 30 feet (9 meters) wide at the base. Structures for loading raw materials and recovering waste gases are on top. Blast furnaces operate continuously until their brick lining wears out. A furnace may function for more than two years before being shut down for repairs.

The term *blast furnace* came from the blast of hot air that is constantly forced into the lower part of the furnace. This air is heated by two or more giant stoves as tall as 125 feet (38 meters). Air is blown through a stove into the furnace. The blast of air enters the furnace through pipes called *tuyères* at between 1400 and 2100 °F (760 and 1150 °C). While air is blown through one stove, the other stove or stoves are being heated.

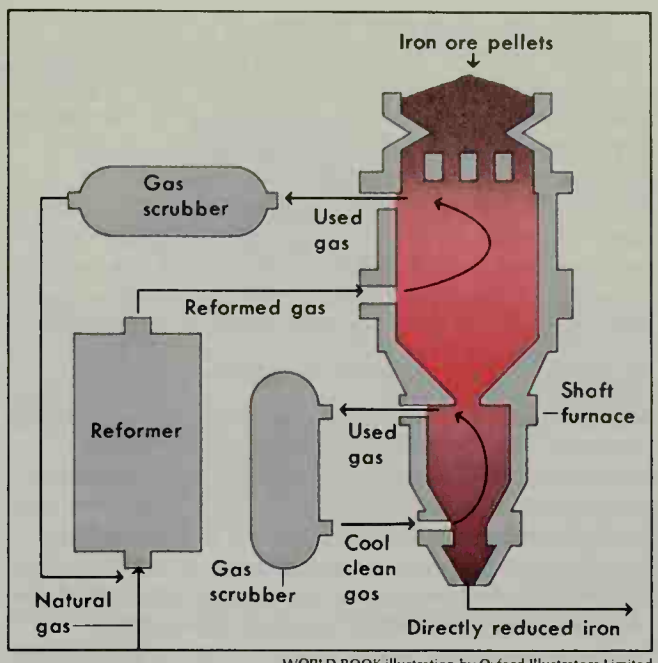
Workers load iron ore, coke, and limestone into the top of the blast furnace. These materials are called the *charge,* and the loading process is known as *charging.* The charge is carried to the top of the furnace by open cars that move up and down tracks on a ramp called a *skip hoist.* At the bottom of the ramp, each skip car is filled with a carefully weighed load of ore, coke, and limestone. At the top of the ramp, the skip car dumps its load into the furnace. In Germany and some other countries, almost all plants use a continuous conveyor belt rather than a skip hoist to load the furnace.

As the materials in the charge go down in the furnace, they contact the blast of hot air. The hot air causes the coke to burn. Oxygen in the air combines rapidly with the coke to produce carbon monoxide gas. This gas is the reducing agent that removes oxygen from the ore. The burning of the coke also produces intense heat, which melts the iron. Temperatures rise above 3000 °F (1600 °C) at the bottom of the furnace. In this area, called the *hearth* or *crucible,* the *molten* (liquid) iron forms a pool 4 to 5 feet (1.2 to 1.5 meters) deep. Molten slag floats on top of this pool. Waste gases rise to the top of the furnace. After devices called *gas scrubbers* clean these gases of dust and other impurities, the gases are burned as fuel in the stoves.

Molten iron is tapped from the furnace every four or five hours. Workers burn out a plug called the *iron notch,* and a white-hot stream of iron rushes through the hole. The iron flows into a *hot-metal car,* which holds more than 150 short tons (136 metric tons) of iron.

The slag is tapped more often than the iron. Workers remove it through a *slag notch* located above the level of the iron. The slag flows into a *slag ladle,* a container mounted on a railroad car. Manufacturers use some slag in making cement and other products but dispose of most of it as waste. Some producers convert slag into sandlike grains called *slag granules.*

Direct reduction converts iron oxide into solid iron called *directly reduced iron.* There are several methods of direct reduction, but the main ones all use reducing gases obtained from natural gas. Each process combines iron ore and reducing gases in a large furnace.



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Direct reduction produces solid iron. In the system above, the *reformer* converts natural gas into hydrogen and carbon monoxide. These gases remove oxygen from the hot ore in the furnace, converting the ore into metallic iron. Cool gas circulates through the lower part of the furnace and cools the iron.

Direct reduction is a major method of producing iron in Mexico, Venezuela, and other nations that have a plentiful supply of cheap natural gas. This method will not become important in the United States and Canada until ironmakers can use gases produced from coal rather than gases obtained from natural gas. Several processes involving coal are being developed.

Furnaces used in direct reduction can be built much more quickly and cheaply than blast furnaces and coke ovens. Direct reduction also causes much less air pollution because coke ovens are a principal source of pollution in ironmaking. But metallic impurities in iron ore are not removed in a direct reduction furnace as they are—by the formation of slag—in a blast furnace. Therefore, the solid iron produced in a direct reduction system must be screened and magnetically cleaned before being charged into a steelmaking furnace.

Making iron products. More than 90 percent of the iron produced in blast furnaces is used in making steel. The rest is cast into pigs and shipped to plants called *foundries,* which produce cast iron and wrought iron.

Casting iron pigs. A pig-casting machine has two conveyor belts that carry shallow molds. Workers pour molten iron from a ladle or hot-metal car into a channel that divides and flows into the molds. Water cools the iron in the molds. By the time the molds reach the end of the conveyor belt, the iron has hardened into pigs that weigh about 40 pounds (18 kilograms).

Making cast iron. At a foundry, workers melt pig iron in a furnace called a *cupola* and then process it into various types of cast iron. The iron is cast in molds to manufacture such products as pipe, automobile engine blocks, and fire hydrants.

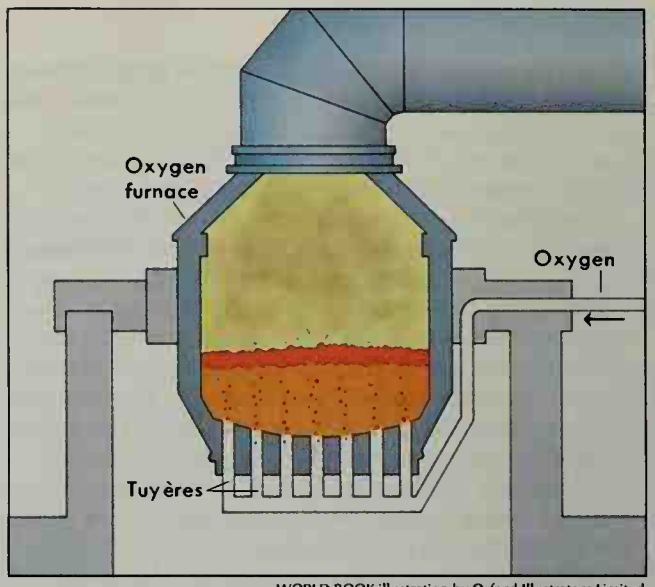
Making wrought iron. To produce wrought iron, workers melt high-quality pig iron and remove most of its impurities. They pour the molten iron over a glassy mass of melted sand called *silicate slag.* The iron and silicate form spongelike balls. These balls are placed in presses that squeeze out the excess slag and form blocks of wrought iron called *blooms.* The processes used to shape wrought-iron blooms into various products are the same as the processes that are used with steel blooms. For a description of these processes, see the *Shaping and finishing steel* section of this article.

How steel is made

Most steel is produced from molten pig iron, directly reduced iron, or scrap iron and steel. Much scrap remains after steel has been manufactured. Steelmakers recycle this scrap along with scrap recovered from such junked products as automobiles and steel cans. Steelmaking primarily involves the removal of excess carbon and other unwanted substances and the addition of desired materials in carefully controlled amounts.

There are three chief methods of making steel: (1) the basic oxygen process, (2) the electric furnace process, and (3) the open-hearth process. In each of these processes, charge materials are placed in a furnace, where the necessary reactions are carried out to produce a *heat* (batch) of refined steel. The rate of steel production varies greatly among the three processes. A basic oxygen furnace produces a heat of steel in about 45 minutes. An electric furnace does the job in about four hours, and an open-hearth furnace takes about eight hours. Steelmaking furnaces range in capacity from less than 50 short tons (45 metric tons) to more than 500 short tons (450 metric tons).

A steelmaking furnace has a control panel lined with dials, gauges, and other instruments. Workers use these instruments to adjust the temperature, pressure, and



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Q-BOP is a version of the basic oxygen process. A Q-BOP furnace has no overhead oxygen lance. Instead, the oxygen is blown in through *tuyères* (pipes) at the bottom of the furnace. Q-BOP makes steel faster than the basic oxygen process.

Making steel by the basic oxygen process In the basic oxygen process, steel is produced by blowing oxygen at high pressure into molten iron and scrap. The oxygen combines with carbon and other impurities, converting the charge into steel. Reactions between oxygen and the charge produce the heat used in the refining process.

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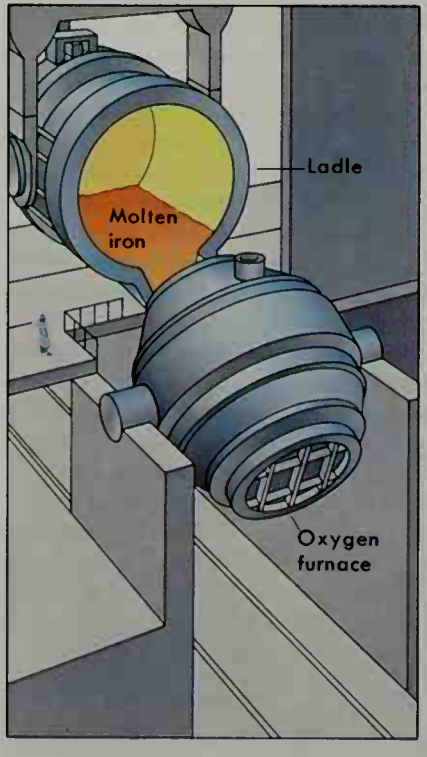
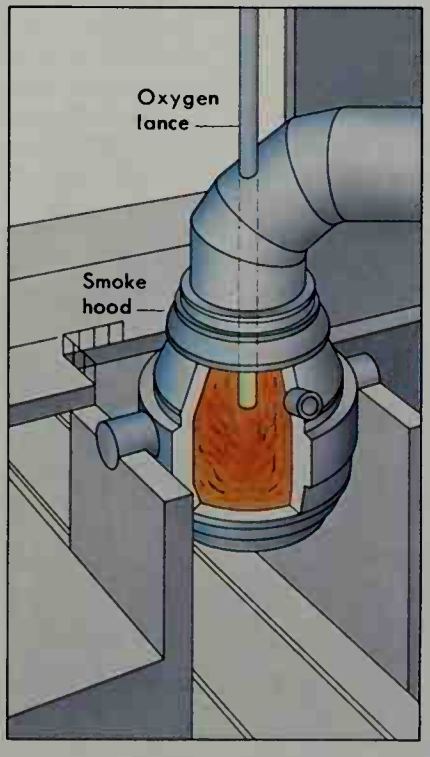
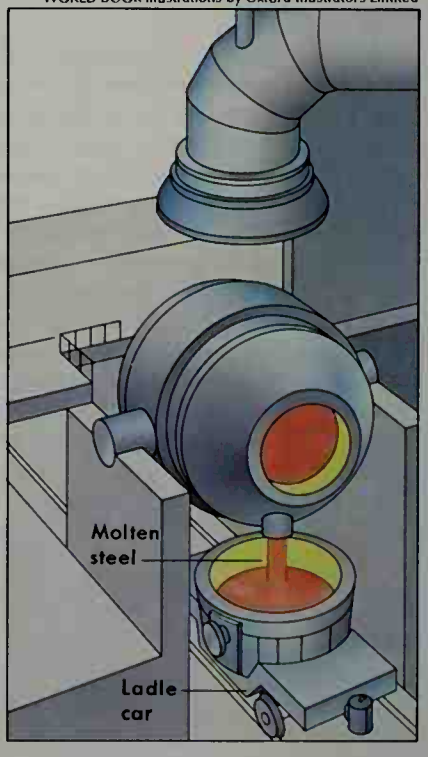


The furnace is tilted for charging. Workers dump in scrap steel and add a ladle of molten iron. Then they return the furnace to its upright position.



Oxygen is blown into the charge through a *lance* (pipe) lowered into the furnace. A smoke hood on top of the furnace captures waste gases.



When refining is complete, the smoke hood and oxygen lance are removed. The furnace is then tilted to pour out the steel through the taphole into a ladle.

Making steel by the electric furnace process

These diagrams show steel being made in an electric arc furnace, the most widely used type of electric steelmaking furnace. The roof of an electric arc furnace has holes through which three carbon rods called *electrodes* are inserted to conduct electricity to the charge.

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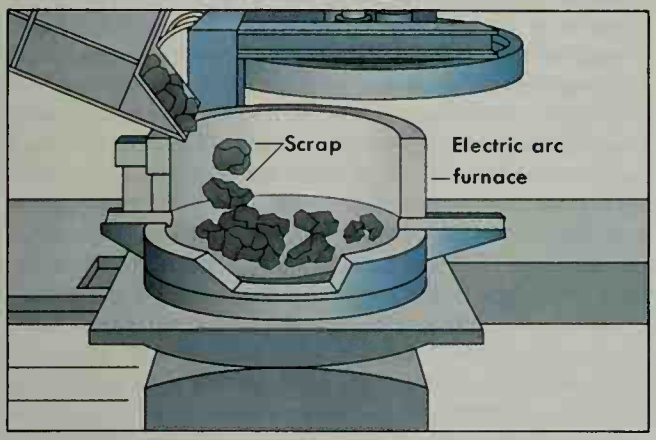
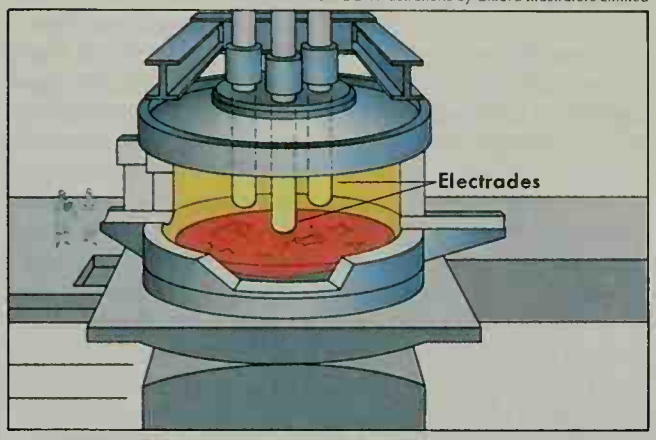
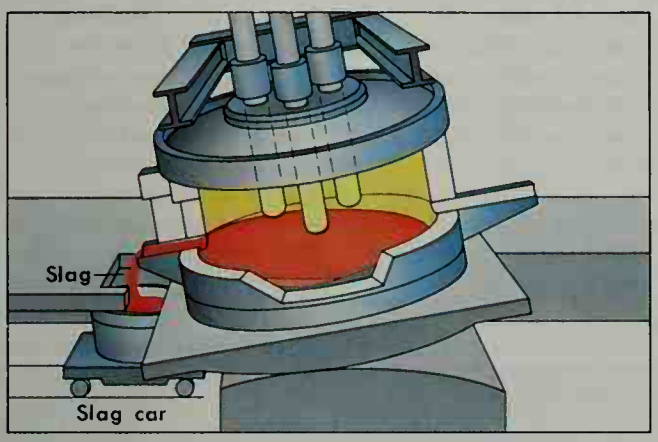


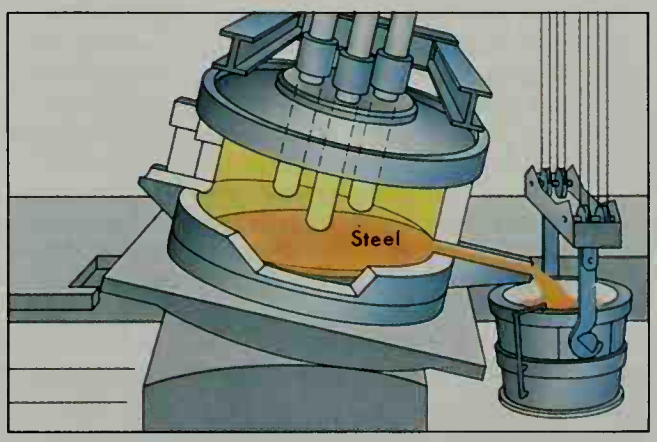
The furnace, with its roof swung aside, is charged with scrap. Steelmakers rarely use pig iron in an electric arc furnace but may use directly reduced iron if it is available at low cost.



A powerful electric current *arcs* (jumps) between the electrodes and the charge. This action produces intense heat, which melts the charge and promotes chemical reactions that produce steel.



Workers turn off the power to the electrodes at the end of the refining process. Then they tilt the furnace, which is mounted on rockers, to pour out the slag.



After the slag has been poured off, the electric arc furnace is tilted in the opposite direction. The liquid steel rushes out through the taphole and is collected in a ladle.

other conditions inside the furnace. Workers also take samples of molten steel from the furnace. Each plant has a laboratory with such instruments as spectroscopes and electron microscopes to analyze samples.

The basic oxygen process (BOP) produces steel by blowing oxygen at high pressure into molten iron and scrap. This method has become increasingly important ever since it was introduced into the United States from Austria in 1954. During the mid-1980's, about 60 per cent of the nation's steel was produced by the basic oxygen process.

A basic oxygen furnace, usually called a *BOF,* is a pear-shaped steel vessel with an open top and heat-resistant lining. The furnace is mounted on *trunnions* (pivots) so it can be tilted for charging and emptying. Basic oxygen furnaces are generally operated in pairs. While one produces steel, the other is being charged.

The usual charge in a BOF consists of about three-fourths molten iron and one-fourth scrap steel. After tilting the furnace and charging it with scrap, workers add a ladle of molten iron and return the furnace to its upright position. Then they lower an oxygen *lance* (pipe) into the furnace to blow pure oxygen onto the charge. The lance operates at a rate of up to 30,000 cubic feet (850 cubic meters) of oxygen per minute. The oxygen penetrates into the molten charge and reacts rapidly with the iron and impurities. These reactions create the heat necessary for the refining process. Fluxes are then added, and a slag soon forms.

As the blowing continues, oxygen combines with carbon and other impurities, converting the charge into steel. The waste gases are trapped by a smoke hood on top of the furnace. The BOF is then tilted to pour the molten steel out through a taphole near the top. The molten steel flows into a ladle, to which workers add alloying materials.

During the 1970's, some steelmakers began to use a new type of oxygen process in which oxygen is blown into the charge through tuyères at the bottom of the furnace. This process, called *Q-BOP,* originated in Europe and was further developed in the United States. The *Q* stands for the German word *Quell,* which means *fountain* and refers to the manner in which the oxygen enters the charge. Any fluxes used are in powdered form and

are blown in along with the oxygen. A Q-BOP unit has no overhead oxygen lance, and so it can be housed under a much lower roof than a basic oxygen furnace. In addition, Q-BOP produces steel faster than BOP.

Both BOP and Q-BOP produce steel at relatively low cost, largely because they require no electricity or fuel oil to create heat. The two processes also produce steel rapidly. In addition, steel produced by these methods is low in nitrogen. Nitrogen reduces the toughness of certain kinds of steel. However, BOP and Q-BOP do not permit as much precision as other processes do in the control of the chemical composition of steel. They also can use only a limited amount of scrap.

The electric furnace process uses electric current to produce the heat needed to make steel. There are several types of electric furnaces, but the most widely used one by far is the *electric arc furnace*. During the mid-1980's, electric arc furnaces produced approximately 35 per cent of the steel manufactured in the United States. Their use is increasing steadily because they operate more efficiently and cost less to build than basic oxygen or open-hearth furnaces.

An electric arc furnace consists of a shallow steel cylinder lined with firebrick. The roof has holes through which three carbon rods called *electrodes* are inserted. A powerful electric current *arcs* (jumps) from each electrode to the charge material and then to another electrode. This arcing produces intense heat, which quickly melts the charge and promotes chemical reactions that produce steel.

The charge in an electric arc furnace consists mostly of scrap steel and alloy materials. Steelmakers rarely use pig iron in this type of furnace. But directly reduced iron is used wherever available at an economical price. The furnace roof is raised and swung to one side so the charge can be dumped in. After the charge has melted, fluxes and alloying material are added through a *charging door* on the side. The furnace stands on rockers and so can be tilted to pour off the slag through the charging door. Later, it is tipped in the opposite direction to pour out the molten steel through the taphole.

Electric arc furnaces are ideal for making certain alloy steels and tool steels. These steels require the addition of alloying elements that readily combine with oxygen. Such elements, which include chromium and vanadium, would be oxidized rapidly in an open-hearth or basic oxygen furnace and thus lost in the slag. The slag in an electric arc furnace contains so little oxygen that alloying elements are not oxidized.

The open-hearth process got its name because the hearth of the furnace is open directly to the flames that melt the charge. The furnace has a lining of firebrick, and a low, arched roof covers the hearth. An open-hearth furnace measures about 90 feet (27 meters) long and about 30 feet (9 meters) wide. Most open-hearth plants have several furnaces end to end in one long

Making steel by the open-hearth process

In an open-hearth furnace, the charge is melted by flames from fuel burners. A charging machine dumps limestone and scrap into the furnace. Oxygen is forced in through a lance in the roof to increase the temperature and thus speed the melting. Workers add molten iron, and continued heating converts the charge into steel. Air used in the furnace is preheated by passing it through hot *checker chambers*. The steel is tapped into a ladle below the level of the furnace.

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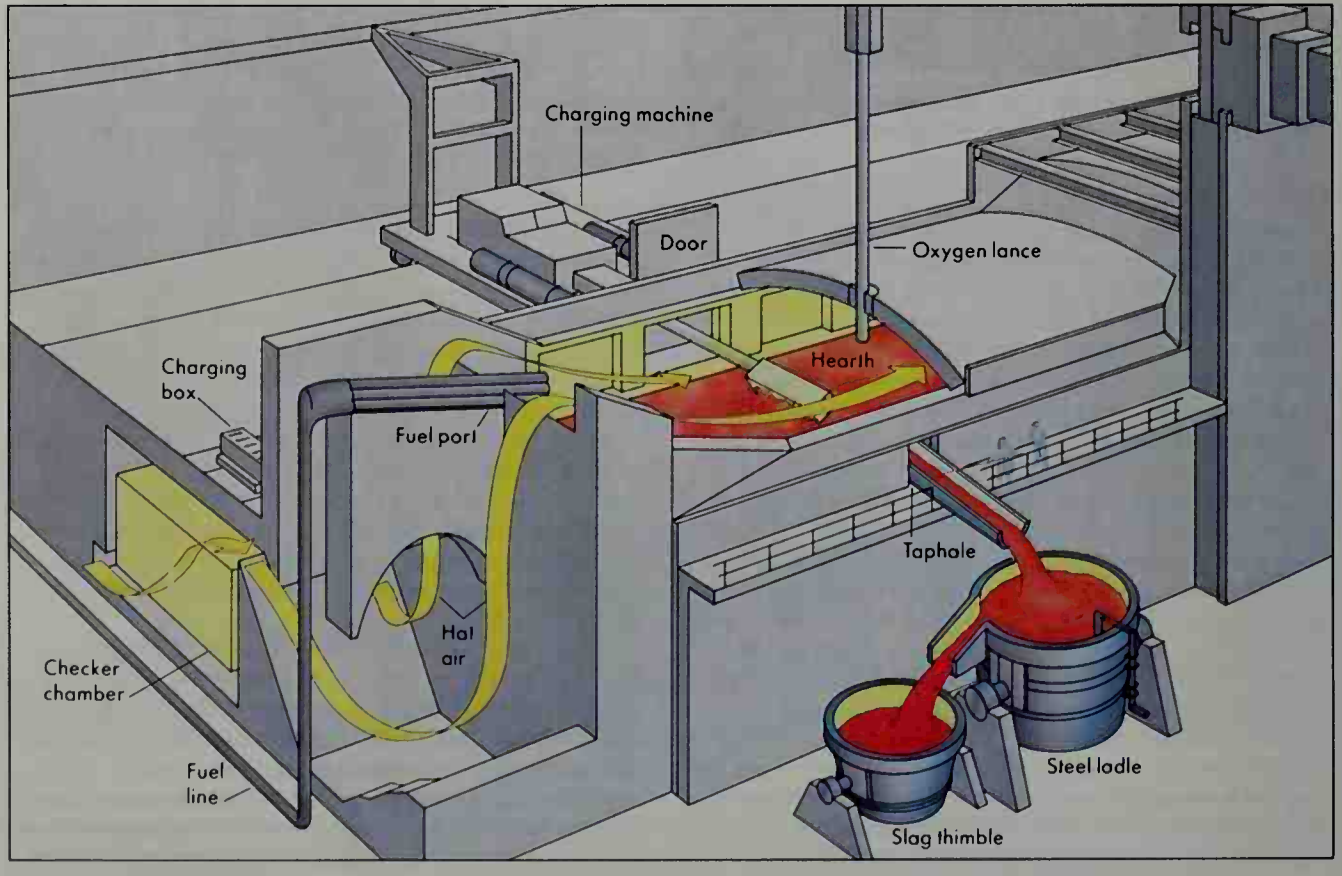

building. Workers fill the furnaces through doors on one side. They tap the steel on the opposite side, where the floor of the building is one story lower.

Each end of an open-hearth furnace has a fuel burner and a chamber called a *checker chamber.* These chambers contain firebricks arranged in a checkered pattern that provides many passages through which air and waste gases can flow. While the burner at one end is burning, the exhaust gases are drawn off through the checker chamber at the other end. These hot gases heat the checker chamber. The furnace automatically switches burners about every 15 minutes, and the flow of gases through the furnace is reversed. Thus, the air on its way to the hearth is preheated by passing through the hot checker chamber. Most open-hearth furnaces also have an oxygen lance in the roof. Pure oxygen is forced through this pipe into the furnace to increase the temperature and so speed the melting process.

Open-hearth furnaces can melt pig iron and scrap in varying proportions, but most steelmakers use about equal amounts of each. First, a charging machine dumps limestone and scrap steel into the furnace. After they have melted, molten iron is poured into the furnace. As the heating continues, most of the carbon from the iron is driven off in the form of carbon monoxide gas. Other impurities are oxidized and become part of the slag. Workers take a sample of the molten steel and may add materials to obtain the desired composition.

To tap the steel, workers blow out the tap-plug with a small explosive. The steel flows into a large ladle. Workers may then add alloying materials or substances to remove oxygen from the steel. When the slag appears, it overflows from the ladle into a smaller container called a *slag thimble.*

The open-hearth process uses expensive fuel oil and makes steel much more slowly than other methods do. It also produces large volumes of waste gases that must be cleaned to reduce air pollution. For these reasons, use of the open-hearth method has declined steadily since 1950, when it was the chief steelmaking process. By the mid-1980's, open-hearth furnaces produced only about 5 per cent of the steel made in the United States.

Special refining processes. Steel tapped from a furnace may require additional refining and alloying. In the simplest case, excess oxygen may be removed from molten steel in the transfer ladle by adding silicon, manganese, and aluminum. More complicated operations involve transferring the molten steel to a special refining vessel. For example, molten steel may be poured into a pear-shaped vessel equipped with tuyères underneath. A mixture of argon and oxygen is blown through the pipes into the metal. This process removes excess carbon from the steel without oxidizing the chromium. Steelmakers also use various types of vacuum systems to remove dissolved hydrogen, oxygen, carbon, and nitrogen from molten steel.

Several complicated and expensive refining processes involve remelting steel after it has hardened into solid metal. These processes improve the purity of steel and help ensure the same quality throughout the product. However, their high cost restricts their use to the production of small amounts of specialty steels.

Shaping and finishing steel

Liquid steel is useless when it comes from the furnace. It must be cast into a solid form before it can be made into useful objects. Steelmakers cast most steel by means of *ingot casting* or *strand casting.* These processes produce solid steel that must be further formed by *rolling, forging, extruding,* or other processes. Some types of steel also receive a special finish or coating. A process called *mold casting* is used for a small amount of steel. This method involves casting steel in a mold that gives it the shape of a finished product.

The various shaping and finishing processes are carefully controlled from elevated platforms. Steel mills have laboratories that test the finished products to assure their high quality.

Ingot casting. Much steel is cast into blocks called *ingots.* Steel ingots vary widely in size, depending on the type of steel and the kind of product to be made. For example, ingots of tool steel may weigh only a few hundred pounds or kilograms. In contrast, huge ingots weighing up to 300 short tons (270 metric tons) are made into parts for enormous industrial machines. Most ingots weigh between 2 and 40 short tons (1.8 and 36 metric tons).

To cast ingots, workers pour liquid steel from a ladle into molds made of cast iron. Most of these molds have a tapered, rectangular shape and are open at both ends. The molds are placed on special railroad cars, and steel is poured in from above. After the steel hardens, the

Casting steel ingots Steelmakers cast molten steel into blocks called *ingots* by pouring it from a ladle into molds made of cast iron, *left.* After the steel hardens, giant tongs remove the molds. The ingots are then put into a *soaking pit, right,* where they are heated to about 2200° F. (1200° C).

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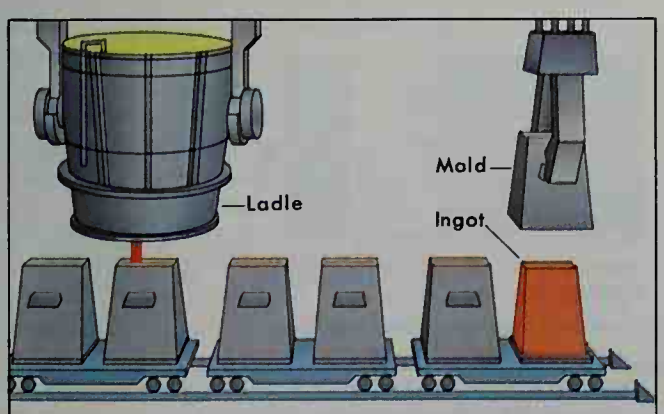

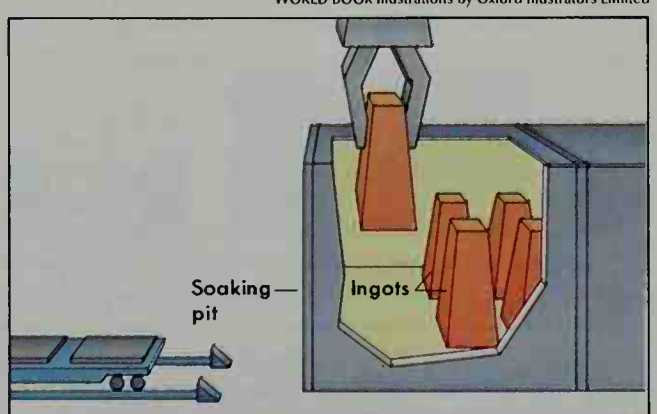

How steel is shaped and finished

Steelmakers use a wide variety of shaping and finishing processes. The diagrams below show two processes that produce semifinished forms of steel called *blooms, billets,* and *slabs;* four methods of shaping these forms into steel products; and a technique used to coat steel products.

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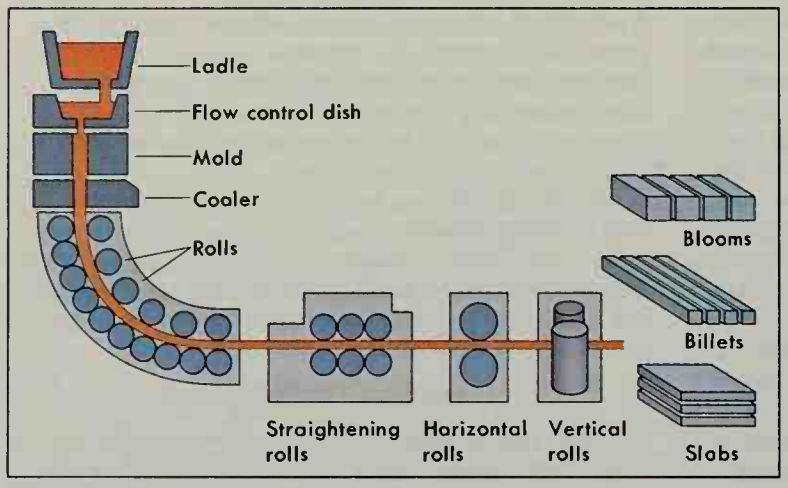
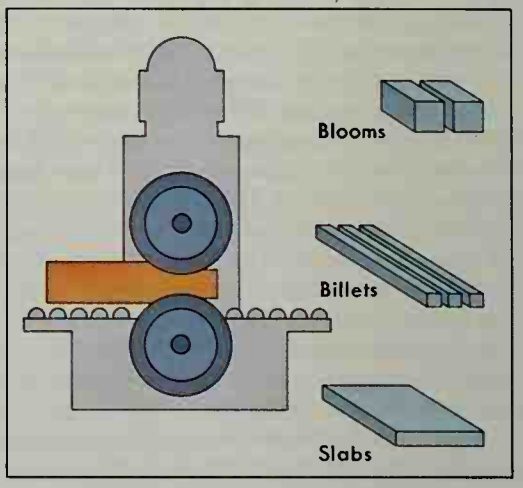
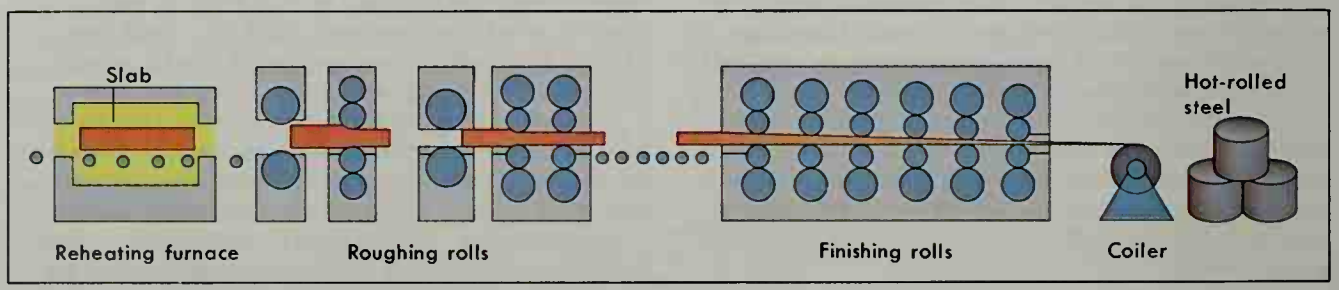


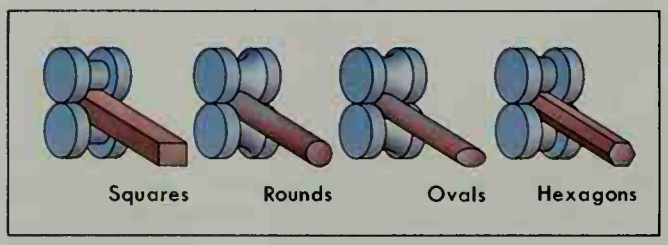
Strand casting shapes molten steel into blooms, billets, and slabs. The steel flows through a specially shaped mold. Cold water quickly cools the steel, causing it to harden as it moves through the rolls of the caster.



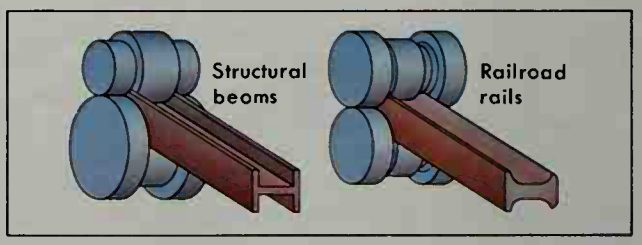
A roughing mill converts heated ingots of steel into blooms, billets, and slabs by squeezing the ingots between heavy rollers.



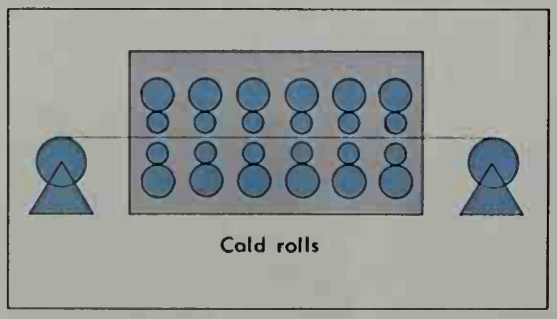
Hot rolling produces sheets of steel. In a *hot-rolling mill,* the roughing rolls reduce the thickness of a reheated slab. Then the finishing rolls squeeze the steel into extremely thin sheets. As the steel comes out of the finishing rolls, it is wound into large coils.



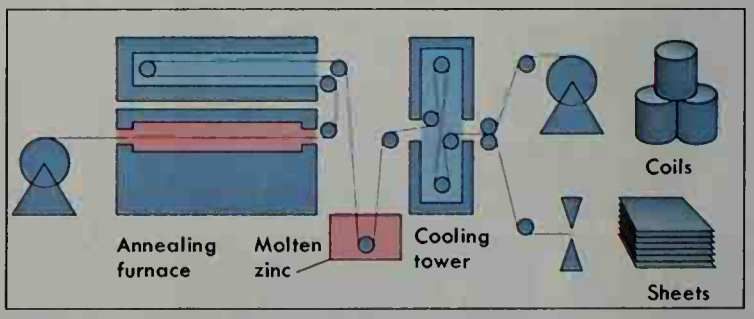
Rolling steel bars takes place in a *bar mill,* which resembles a hot-rolling mill. A bar mill has rolls that are grooved to roll hot billets into square, round, oval, or hexagonal bars.



Rolling railroad rails and structural beams is performed by mills similar to bar mills. However, steel companies manufacture most rails and beams from blooms.



Cold rolling smooths and thins steel sheets. In a *cold-rolling mill,* steel travels at room temperature through a series of rollers and then is recoiled.



Galvanizing involves coating steel with zinc to make it resist corrosion. The steel is *annealed* (heated and slowly cooled), passed through molten zinc, and then cooled to harden the coating.

mold is lifted off by giant tongs that grip it by handles on the sides. The ingots are then placed in a heated pit called a *soaking pit,* where they remain until they have a temperature of about 2200° F. (1200° C) throughout.

The heated ingots travel to a *roughing mill,* a machine that squeezes them between heavy rollers into longer and thinner shapes. Roughing mills produce three semi-finished forms of steel: (1) blooms, (2) billets, and (3) slabs. Blooms have a square cross section, and slabs are rectangular in cross section. Billets are square like blooms but have a smaller cross section. Most billets are much longer than blooms.

Strand casting produces blooms, billets, or slabs directly from molten steel. Strand-casting machines make it possible for steelmakers to avoid the costly and time-consuming processes of casting, heating, and rolling ingots.

In strand casting, workers pour liquid steel from a ladle into a *tundish* (flow control dish) at the top of the machine. The steel flows at a controlled rate from the tundish through a mold that forms the metal into the desired shape. Cold water quickly cools the steel, causing it to harden as it continues to move through the caster. As the steel leaves the caster, a moving torch cuts it into the desired lengths.

Rolling is the most commonly used method of shaping steel products. In this process, billets, blooms, or slabs pass between heavy rollers that squeeze them into the desired size and shape. The major products made by rolling include (1) sheet and strip, (2) bars, (3) railroad rails and structural beams, and (4) plates.

Sheet and strip are flat products, generally less than $\frac{1}{4}$ inch (6.4 millimeters) thick. Strip is much narrower than sheet, which may be up to 100 inches (250 centimeters) wide. Sheet and strip are the main products of the steel industry. Together, they account for more than a third of the steel produced in the United States.

Steelmakers produce most sheet and strip in the form of large coils that the user can cut into pieces of any desired length. However, some comes from the steel plant cut into specified lengths. Most sheet and strip is used in automobile bodies, but thousands of other products also contain these forms of steel.

Machines called *hot-rolling mills* produce sheet and strip from slabs and billets. The process is known as *hot rolling* because the steel is reheated to about 2200° F. (1200° C) before being rolled. A hot-rolling mill has many sets of rollers called *roll stands* arranged in a long line. In each roll stand, the rollers are closer together than in the preceding stand. As a result, the steel is squeezed thinner and thinner as it travels through the mill. As the thickness decreases, the length increases.

A hot-rolling mill can convert a slab 5 inches (13 centimeters) thick and 8 feet (2.4 meters) long into a sheet $\frac{1}{16}$ inch (1.6 millimeters) thick and 1,400 feet (430 meters) long. The process takes only a few minutes. A hot-rolling mill may be housed in a building up to 1 mile (1.6 kilometers) long. This great length is necessary because of the large number of roll stands and the tremendous increase in the length of the steel. As the hot-rolled steel comes out of the last stand, the steel is wound into large coils.

After being cooled, the coils of steel may be shipped to customers or may be processed further. Much hot-rolled sheet and strip is *pickled* and then *cold-rolled.* Pickling involves passing the steel through vats of acid to remove the oxide that formed on it during hot rolling. In a *cold-rolling mill,* the steel travels rapidly at room temperature through a series of roll stands and then is recoiled. Cold rolling gives steel the ability to be stretched and shaped without cracking. It also makes steel thinner and smoother and gives it a bright finish.

Bars are the second leading product of the steel industry. Products made from steel bars include hand tools and automobile parts. Steel companies make bars in many sizes and in such shapes as round, square, oval, and hexagonal. Bars are hot rolled by *bar mills,* which resemble the machines used for sheet and strip. However, a bar mill has grooved rolls that squeeze a hot billet into the desired shape. Many bars receive further processing after being hot rolled. They are pulled at room temperature through an opening in a tool called a *die.* This process strengthens the steel and gives it a bright, smooth finish.

Railroad rails and structural beams are hot-rolled into long lengths in the same way as bars. But steelmakers produce many structural shapes, such as I-beams and H-beams, according to the instructions of a specific customer. Most railroad rails and structural beams are made from blooms.

Plates are flat and measure more than $\frac{1}{4}$ inch (6.4 millimeters) thick. They are used in the construction of ships and bridges and in many kinds of industrial and scientific equipment. Steel plants roll most plates from slabs, but some come directly from ingots. Machines called *reversing mills* produce the majority of plates. The heated steel passes back and forth between the rollers of a single roll stand. The distance between the rolls decreases each time until the steel reaches the desired thickness. Some plates are made by continuous rolling mills like those that produce sheet and strip.

Forging is a process in which steel manufacturers heat ingots or billets and hammer or press them into the desired shape. Many products that must withstand great stress are made by forging. This process changes the internal structure of steel to give it the greatest strength where needed. The largest forging presses shape ingots weighing several hundred tons.

Extruding involves forcing heated steel through an opening in a die. A ram at one end of a cylinder pushes the steel through a die at the other end. Molten glass serves as a lubricant to help the hot steel slip through the die. The steel comes out shaped like the die opening. Steel firms use extrusion for seamless tubing and products of various complicated shapes.

Other shaping processes are used in making a variety of small steel products. Automatic machines stamp, hammer, and press steel into such products as bolts, nails, screws, and tools. Wire is made by drawing steel rods through a series of successively smaller dies.

Finishing. Many types of steel receive a special finish or coating. For example, some stainless steel goes through special grinding and polishing. The most important coating processes include (1) galvanizing and (2) electroplating.

Galvanizing is the process of coating steel with a thin layer of zinc. The zinc coating makes the steel highly resistant to corrosion. Each year, millions of tons of galva-

Leading steel-producing countries

Tons of steel produced in a year

China	136,970,000 tons (124,260,000 metric tons)
United States	107,370,000 tons (97,400,000 metric tons)
Japan	103,830,000 tons (94,200,000 metric tons)
Russia	54,850,000 tons (49,760,000 metric tons)
Germany	46,360,000 tons (42,060,000 metric tons)
South Korea	45,240,000 tons (41,040,000 metric tons)
Ukraine	29,500,000 tons (26,760,000 metric tons)
Brazil	27,550,000 tons (25,000,000 metric tons)
Italy	27,520,000 tons (24,960,000 metric tons)
India	26,750,000 tons (24,270,000 metric tons)
France	22,280,000 tons (20,210,000 metric tons)
United Kingdom	18,340,000 tons (16,630,000 metric tons)

Figures are for 1999.
Source: U.S. Geological Survey.

WORLD BOOK map

nized steel sheet are made into such products as heating ducts and storage tanks. The most widely used method of galvanizing, called *hot-dip galvanizing,* starts with coils of steel sheet. The steel is *annealed* (heated and then cooled slowly) to make it more flexible. Next, rollers carry the steel into a pot of molten zinc. The steel then travels through a cooling tower, where the zinc coating hardens. The finished product is wound into coils or cut into sheets.

Electroplating puts a coating of another metal on steel by means of electric current. Steel companies use this process in producing huge quantities of tin-plated steel, which is made into tin cans. Steel is electroplated with chromium in making so-called *tin-free steel.* This metal can be used instead of tin-plated steel in manufacturing cans and other containers.

Leading steel-producing states and provinces

Tons of steel produced in a year

Indiana	25,650,000 tons (23,270,000 metric tons)
Ohio	17,500,000 tons (15,880,000 metric tons)
Ontario	12,790,000 tons (11,600,000 metric tons)
Pennsylvania	8,320,000 tons (7,550,000 metric tons)
Illinois	6,930,000 tons (6,290,000 metric tons)
Michigan	6,570,000 tons (5,960,000 metric tons)
Texas	3,900,000 tons (3,540,000 metric tons)
Quebec	2,780,000 tons (2,520,000 metric tons)

Figures are for 1999.
Sources: American Iron and Steel Institute; Ontario and Quebec figures are *World Book* estimates based on data from Statistics Canada.

The steel industry

Steelmaking ranks among the world's most important industries. Steel products play an essential role in almost all major economic activities, including manufacturing, mining, construction, transportation, and agriculture. In addition, the military forces of all nations depend on steel for their operations. China produces more steel than any other nation, followed by the United States and Japan. In some countries, the government owns and manages the steel industry. In other countries, the industry consists of privately owned companies. Still other nations have a mixture of private and public ownership. Even in nations where the entire steel industry is privately owned, the government generally plays a major role in regulating it.

The manufacturing plants that make up the steel industry vary greatly in size. The largest plants have a full range of equipment, including coke ovens, blast furnaces, steelmaking furnaces, and rolling mills. Most of

This map shows the world's major steelmaking centers and iron ore deposits. It also shows areas that have large deposits of coking coal, an important raw material in steelmaking.

these plants produce from about 1 million to 10 million tons (900,000 to 9,000,000 metric tons) of steel annually. A small steel plant may consist only of an electric furnace to melt scrap and a mill that produces bars. Such a plant may produce less than 100,000 tons (90,000 metric tons) yearly.

In the United States, the steel industry has the capacity to make about 130 million tons (118 million metric tons) of steel annually. But actual production varies with the general level of economic activity. The demand for steel rises when construction and manufacturing maintain a high rate. When these activities decline, so does steel production. In the mid-1990's, U.S. steel companies produced about 100 million tons (90 million metric tons) of steel annually.

The steel industry in the United States consists of about 80 private companies. These firms operate about 160 plants. The largest company, United States Steel Corporation, produces about a fifth of the nation's steel. Other major companies include Armco Steel Corporation, Bethlehem Steel Corporation, Inland Steel Company, LTV Steel Company, and National Steel Corporation. These companies own not only steel mills but also coal mines, iron ore mines, and limestone quarries. Some also operate their own railroads and ore boats to transport raw materials.

About two-thirds of the nation's steel is produced by five states: Illinois, Indiana, Michigan, Ohio, and Pennsylvania. The steel companies supply all their own coal. However, they import about a third of their iron ore from Canada and various African and South American nations. In addition, the steel companies import such important alloying elements as chromium, cobalt, and manganese.

About 170,000 people work in the plants and offices of the American steel industry. About 70 percent of them are production and maintenance workers, and the rest have professional, administrative, and clerical positions. The highly technical nature of steelmaking offers many opportunities for chemists, engineers, technicians, and *metallurgists* (experts on metals). Steel companies also employ a large number of salespeople.

Nearly all nonmanagement employees in the steel industry belong to one labor union, the United Steelworkers of America (USWA). The USWA, one of the largest labor unions in the United States, has done much to gain higher wages and better working conditions for steelworkers.

The United States government regulates the steel industry in a number of ways. Federal standards for clean air and water have required steel companies to reduce the environmental pollution produced by their plants.

The Occupational Safety and Health Administration (OSHA) establishes regulations to protect the health and safety of workers. From time to time, the United States government has also taken actions to control the price of steel.

The steel industry in the United States faced serious challenges during the 1980's. Competition from imported steel reduced the demand for American steel and helped lead to the closing of many plants. Other mills operated with outdated equipment and production methods. Disagreements arose between the steel industry and the federal government over several issues. These issues included taxation, investment in new equipment, environmental standards, trade agreements, and the effect of plant closings on workers and communities.

By the early 1990's, however, several of the large U.S. steel companies had modernized production methods at some of their facilities. Steel production in the United States increased steadily throughout the 1990's.

In Canada, steel companies employ about 50,000 workers and produce more than 15 million tons (14 million metric tons) of steel annually. Ontario is by far the leading steel-producing province. The southeastern portion of Ontario is the main center of Canada's steel production. Quebec is also an important steel-producing province.

Canada's plentiful iron ore, coal, and other raw materials help keep its steel industry strong. The country's largest steel manufacturer is the Steel Company of Canada (Stelco). This company produces more than a third of the nation's steel.

In other countries. China, Japan, and the United States are among the world's leading steel-producing nations. Each country produces more than 100 million tons (90 million metric tons) of steel annually.

China has all the raw materials it requires to produce its steel. But Japan must import nearly all of its materials. However, Japan's steel mills are among the most modern in the world. As a result, the country is able to export steel widely at a competitive cost.

Other major steel-producing nations include Russia, Germany, and South Korea. These countries each produce around 50 million tons (45 million metric tons) of steel annually.

Before about 1950, the developing nations imported all their steel from the United States and other major industrial nations. Since then, however, many developing nations have established their own steel industries. Such growth has been especially important in countries that have plentiful natural gas and iron ore, such as Mexico and Venezuela. These nations have built plants that produce directly reduced iron and refine it into steel in electric arc furnaces.

Brazil, one of the world's major steel-producing nations, uses traditional methods instead of electric arc furnaces. Even in countries without a wealth of raw materials, governments have helped establish modern steel industries.

History

The Iron Age. Prehistoric people obtained iron from meteorites and used it to make tools, weapons, and other items. In several early languages, the word for iron meant *metal from the sky.* People used such iron as early as 4000 B.C., but no one knows when or where they first made iron by smelting ore.

The first people known to have large supplies of iron were the Hittites, who lived in what is now Turkey. By about 1400 B.C., they had learned to make iron and to harden iron weapons and tools. People in China and India also developed methods of making iron. By 1000 B.C., most of the world's advanced civilizations knew ironmaking techniques, and the Iron Age was well underway (see **Iron Age**).

The early ironmaking furnaces were shallow, bowl-shaped hearths in which people heated iron ore and charcoal. After several hours, the ore released its oxygen to the surrounding hot carbon and changed into a shiny metal. But before it could be used, this metallic

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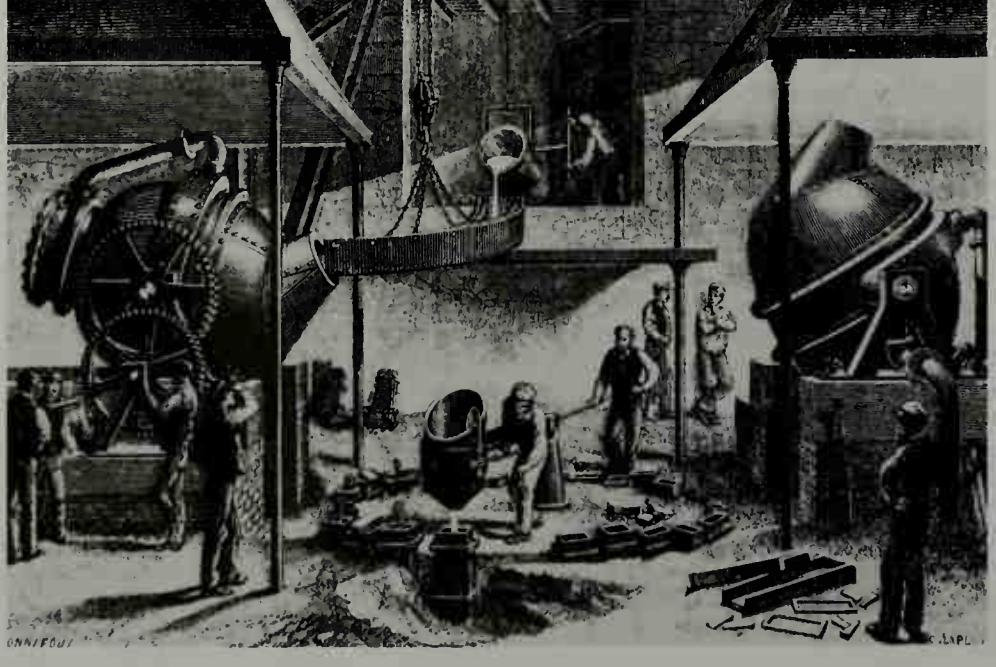


The Bessemer process was the chief method of making steel during the late 1800's. This picture of a Bessemer plant shows workers charging molten iron into a Bessemer converter and pouring liquid steel into ingot molds.

iron had to be reheated and hammered repeatedly to force out the remaining hard, brittle impurities. By 1200 B.C., ironworkers could reheat, work, and cool iron to make wrought iron with properties similar to those of some modern carbon steels.

Ironmakers soon learned that blowing air into the furnace through tuyères made the fire hotter and thus improved the quality of the iron. Later, they used a device called a *bellows* to blow air through the tuyères. About A.D. 700, ironworkers in the area of Catalonia, in what is now northeastern Spain, developed a better type of hearth furnace. In this furnace, called the *Catalan forge,* air was forced in at the bottom by water power. The Catalan forge produced about 350 pounds (159 kilograms) of wrought iron in five hours, far more than could be made by earlier furnaces.

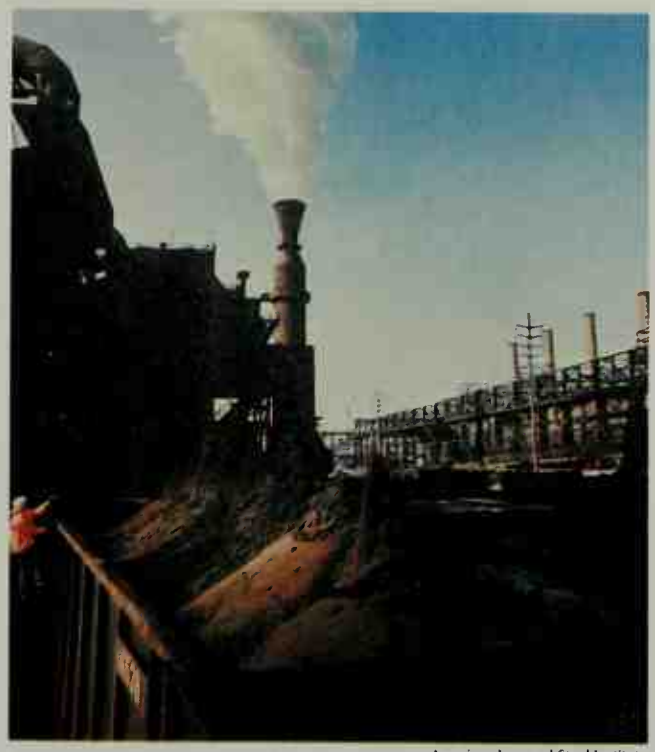
During the Middle Ages, from the A.D. 400's to the 1500's, ironworkers developed *shaft furnaces.* These furnaces had a much higher shaft than hearth furnaces did. Workers dumped in the iron ore and charcoal through this shaft, which was lined with bricks. Ironworkers of the 1300's built the first blast furnaces, which were shaft furnaces that made molten iron. With the development of the blast furnace, ironmaking became a thriving business throughout Europe. However, methods of shaping liquid iron into commercial products were not developed completely until about 1500. During the 1700's, British ironmakers began to use coke instead of charcoal in their blast furnaces due to a shortage of wood.

The English colonists brought ironmaking with them to the New World. An ironworks operated briefly on the James River in Virginia before being destroyed during an Indian raid in 1622. In 1646, the first North American ironworks to maintain production for a long period opened in what is now Saugus, Mass. It continued to operate until about 1678. By 1775, American blast furnaces were producing 30,000 short tons (27,000 metric tons) of cast iron yearly. This production accounted for 15 per cent of the world's annual output of cast iron.

The first steel. Small amounts of some forms of steel were made during the early part of the Iron Age. For example, the Haya people of eastern Africa made steel in special shaft furnaces. In southern India, as early as 300 B.C., spongy masses of iron were worked and reheated to make *wootz steel.* By the A.D. 400's, the Chinese were also producing steel.

Europeans produced small quantities of steel throughout the Middle Ages. However, such steel was both scarce and expensive. In 1740, a British clockmaker named Benjamin Huntsman invented the *crucible process* of steelmaking, which closely resembled the method used for producing wootz steel. Huntsman remelted and refined high-quality wrought-iron bars in clay *crucibles* (melting pots). This process was slow and required a great deal of labor. In addition, the largest crucibles were able to produce only about 100 pounds (45 kilograms) of steel.

The birth of modern steelmaking. The first method of making steel cheaply in large quantities was developed during the mid-1800's. This method, called the *Bessemer process,* was created by Henry Bessemer, a British steel manufacturer. An American ironmaker named William Kelly developed the process independently in the United States. However, neither Bessemer nor Kelly could have produced steel without knowing about a discovery made in 1857 by Robert Mushet, a British metallurgist. Mushet found that adding an iron-carbon-manganese alloy, called *spiegeleisen,* during refining helped remove oxygen and adjust the carbon content of the steel.



American Iron and Steel Institute

Controlling air pollution is an important activity in modern steel mills. The carload of dust shown above was removed from waste gases released during steel production.

In the Bessemer process, workers took molten iron from the blast furnace and poured it into a pear-shaped container called a *converter.* Then they injected air into the iron through tuyères in the bottom of the converter. The oxygen in the air reacted rapidly with the impurities in the molten iron. This action, together with the addition of spiegeleisen, converted the iron into steel.

The Bessemer process was used in the United States for the first time in 1864. By 1880, this method accounted for more than 90 per cent of U.S.-manufactured steel.

The open-hearth process appeared soon after the Bessemer method became widespread. In 1856, two German-born scientists living in Great Britain, Charles William Siemens and his brother Friedrich, invented the *regenerative gas furnace.* This furnace used hot waste gases to preheat the fuel and air put into it. In 1864, two French brothers, Pierre and Émile Martin, made steel in a furnace built by the Siemens' engineers. The method used by the Martins—called the Siemens-Martin, or open-hearth, process—had many advantages over the Bessemer process. Most importantly, it produced steel from scrap and allowed greater control over the chemical composition of the product. Few Bessemer plants were built after 1910, though existing ones continued to operate until the 1960's.

In 1878, William Siemens demonstrated that steel could be refined in an electric arc furnace. But at that time, electricity was limited in supply and extremely ex-

Inland Steel Company

Computer-controlled equipment performs many operations in steel plants. These workers are monitoring the computers that control a large blast furnace at an Indiana steel mill.

pensive. In 1899, Paul Héroult of France opened the first steel mill equipped with electric arc furnaces.

Growth of the steel industry. After the introduction of the Bessemer and open-hearth processes, steel manufacturing began to expand rapidly. During the mid-1800's, rich iron ore ranges were discovered in the Lake Superior region of the United States. The discovery of this ore led to the development of the nation's steel industry. Germany and the United Kingdom became the leading European producers of steel.

The annual production of steel in the United States increased tremendously between 1880 and 1910. During this period, production rose from about 1,400,000 tons (1,300,000 metric tons) of steel to more than 28 million tons (25 million metric tons) of steel. In 1873, Andrew Carnegie had established the first large-scale steel plant in the United States, the Edgar Thomson works in Braddock, Pennsylvania. Carnegie later built a number of other steel plants.

In 1901, Carnegie sold his mills to the newly formed United States Steel Corporation. Through this purchase, United States Steel gained control of about 65 percent of the nation's steelmaking capacity. Its share of the industry gradually declined as other major steel firms were established. But United States Steel remained the nation's largest steelmaker.

Much of the steel produced in the late 1800's was used to make rails for the railroads of the United States and Europe. During the 1900's, production continued to increase to meet the rising demand for steel for automobiles and countless other products. The development of new and more efficient production methods also advanced rapidly. These developments included new processes for rolling and shaping steel and the creation of new alloys.

Most of the world's major steel industries, except that of the United States, were severely damaged during World War II (1939-1945). As a result, U.S. companies dominated world steel production during the postwar years. However, Japan and many European nations rebuilt their steel plants in the 1950's and 1960's. The new mills used the most modern techniques, including the basic oxygen process and strand casting. This modernization gave the Japanese and European steel industries an advantage over the American industry, which generally continued to use old equipment.

Recent developments. The growth of steel production in the developed nations declined greatly during the 1970's because of a general economic slowdown. However, world production continued to rise, primarily because of rapidly expanding steel output in the developing nations of South America and Asia.

Since the 1980's, many steel companies have installed completely automated, high-speed production equipment with computer control systems. The creation of such equipment has required the combined skills of metallurgists, engineers, instrument specialists, and computer programmers. Researchers in the steel industry have worked to develop new methods to convert coal into coke. They also hope to develop new direct-reduction processes based on coal. In addition, scientists and engineers continue their search for better steelmaking processes and new alloys for use in steel production.

Donald deB. Beaver

Related articles in *World Book* include:

Biographies

Bessemer, Sir Henry
Carnegie, Andrew
Cooper, Peter
Gary, Elbert H.
Murray, Philip

Making and shaping iron and steel

Alloy
Cast and casting
Ductility
Electroplating
Extrusion
Forging
Foundry
Galvanizing
Ironwork, Decorative
Metallurgy
Nail
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Hematite
Industrial Revolution
Iron
Iron Age
Limestone
Manganese
Mesabi Range
Rust
South America (picture)
Steelworkers of America, United
Taconite
Technology (picture: An automated steel mill)
United States Steel Corporation

Outline

I. Kinds of iron and steel
- A. Pig iron
- B. Cast iron
- C. Wrought iron
- D. Carbon steel
- E. Alloy steel
- F. Stainless steel
- G. Tool steel

II. Sources of iron ore
- A. Kinds of iron ore
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III. Mining and processing iron ore
- A. Open-pit mining
- B. Underground mining
- C. Processing

IV. How iron is made
- A. Raw materials
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V. How steel is made
- A. The basic oxygen process

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D. Special refining processes

VI. Shaping and finishing steel
A. Ingot casting
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D. Forging
E. Extruding
F. Other shaping processes
G. Finishing

VII. The steel industry
A. In the United States
B. In Canada
C. In other countries

VIII. History

Questions

What are the main raw materials used to make iron in a blast furnace?
What determines the physical properties of a particular kind of iron or steel?
How were the world's largest deposits of iron ore formed?
In what ways does the United States government regulate the steel industry?
What is the principal alloying element in stainless steel?
Which of the three major steelmaking processes produces steel most rapidly?
Which five states produce most of the steel made in the United States?
What is *pig iron*? How did it get its name?
What is the most commonly used method of shaping steel products?
What was the *Catalan forge*? When and where was it developed?

Additional resources

Level I

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Level II

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Rogovin, Milton, and Frisch, Michael. *Portraits in Steel.* Cornell Univ. Pr., 1993.
Seely, Bruce E., ed. *Iron and Steel in the Twentieth Century.* Facts on File, 1994.

Iron and Steel Institute, American, is an association of producers of iron and steel in North and South America. Its principal purposes are (1) to promote interest in the iron and steel industry, (2) to collect and distribute information about the iron and steel industry, (3) to coordinate collaborative research for the industry, (4) to provide a forum for the exchange of information and discussion of problems in the industry, and (5) to promote the use of iron and steel.

The first formal association of U.S. iron and steel producers was formed in 1855 and became known as the American Iron and Steel Association. The American Iron and Steel Institute, organized in 1908, absorbed the association in 1912. The institute has over 50 company members and over 1,000 individual members. Headquarters are in Washington, DC.

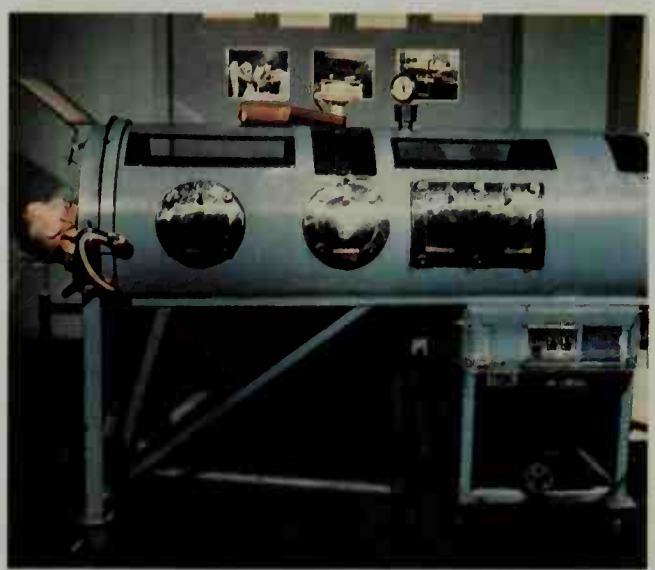
Critically reviewed by the American Iron and Steel Institute

Iron Curtain is a phrase made popular by Sir Winston Churchill in the 1940's. The phrase referred to the Soviet Union's isolation policy after World War II. The Soviet Union set up trade barriers and a rigid censorship that cut off the country and its Eastern European "satellite" countries from the rest of the world. Burton I. Kaufman

See also Cold War (The Iron Curtain descends).

Iron lung is a device used to treat paralysis of the muscles and organs of breathing. The iron lung is sometimes called a *respirator.* In cases of paralysis, the chest loses its muscle action, and the patients are in danger of suffocation because they cannot get enough air into their lungs. The use of the iron lung helps afflicted people breathe.

The iron lung is a large metal tank with an attached pump that changes the amount and pressure of the air within the tank. The patient lies inside the tank with only his or her head outside. A rubber collar at the neck keeps air from escaping. From 15 to 30 times a minute, the pump withdraws air from the tank, the patient's chest rises, and air enters through the nose and mouth. When air flows back into the tank, the chest lowers, and the patient exhales. This process has helped many patients during severe attacks of poliomyelitis and other diseases that cause respiratory paralysis. Patients have remained in iron lungs for several years.



Otis Historical Archives

An iron lung helps a person breathe despite paralyzed chest muscles. Only the patient's head lies outside the machine. Panels in the tank's side can be opened to enable a physician to examine the patient.

Philip Drinker and Louis A. Shaw developed the first practical iron lung in 1928 at the Harvard School of Public Health in Boston. The iron lung saved many lives during the 1950's, when polio epidemics broke out in the United States. Today, other kinds of respiratory machines are more commonly used. Brian J. Sproule

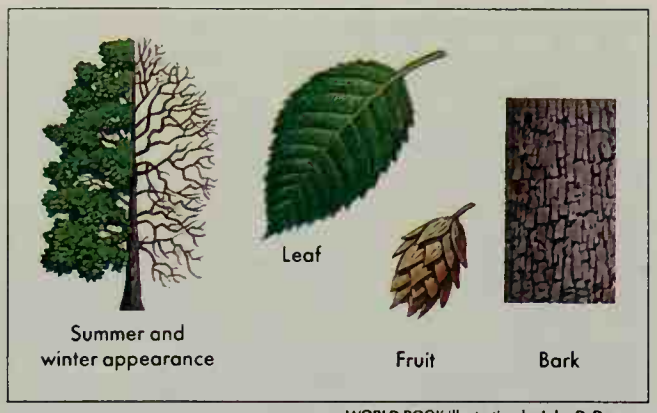
Iron ore. See Iron and steel (Sources of iron ore; Mining and processing iron ore).

Iron pyrite. See Pyrite.

Ironclad. See Monitor and Merrimack.

Ironsides, Old. See Constitution (ship).

Ironwood, or *hornbeam,* are names given to certain trees that have exceptionally hard wood. In North America two well-known species in the birch family are in this



WORLD BOOK illustration by John D. Dawson

The ironwood is a hardwood birch tree. A species called the *hop hornbeam, above,* has fruit clusters that look like hops.

group. One of these is the *hop hornbeam,* or *ironwood,* which is a small forest tree that grows east of the Rocky Mountains. Hop hornbeam trees usually grow singly. The slender trunks of this tree grow from 25 to 50 feet (8 to 15 meters) tall and have grayish, flaky bark. The tree's leaves look like birch leaves, and the fruit clusters look like hops.

The other species is called *American hornbeam, blue beech,* and *water beech.* It is common in moist places east of the Rocky Mountains. Its blue-gray bark is smooth except on old trees. The slender trunks are bumpy and swollen in ridges under the close-fitting bark.

Scientific classification. The ironwoods belong to the birch family, Betulaceae. The hop hornbeam is *Ostrya virginiana.* The American hornbeam is *Carpinus caroliniana.*

Norman L. Christensen, Jr.

Ironwork, Decorative, usually consists of different lengths and thicknesses of iron rods that have been shaped into designs. Examples can be seen in doorknockers, gates, fences, fireplace screens, hinges, weather vanes, and grilles.

The most common designs are twists along the length of an iron rod. The ends of the rod may be curved or curled in a snakelike fashion, or they may be flattened, pointed, or looped. Other flat, round, and square pieces of metal may be welded onto the rod. The ironwork may have a textured surface formed by blows from a hammer.

Decorative ironwork was a popular craft through the early 1900's. A blacksmith or ironworker created decorative ironwork by heating iron in a coal-fired furnace called a *forge* until the iron softened, and then hammered it into a design. By the mid-1900's, handmade methods were largely replaced by industrial cast-iron procedures, which reproduced shapes quickly and inexpensively. Beginning in the late 1970's, handmade decorative ironwork regained popularity. Today, craftworkers may re-create ancient and traditional decorations or develop new designs. They often receive commissions to create ironwork specifically for homes, hotel lobbies, museums, and office buildings.

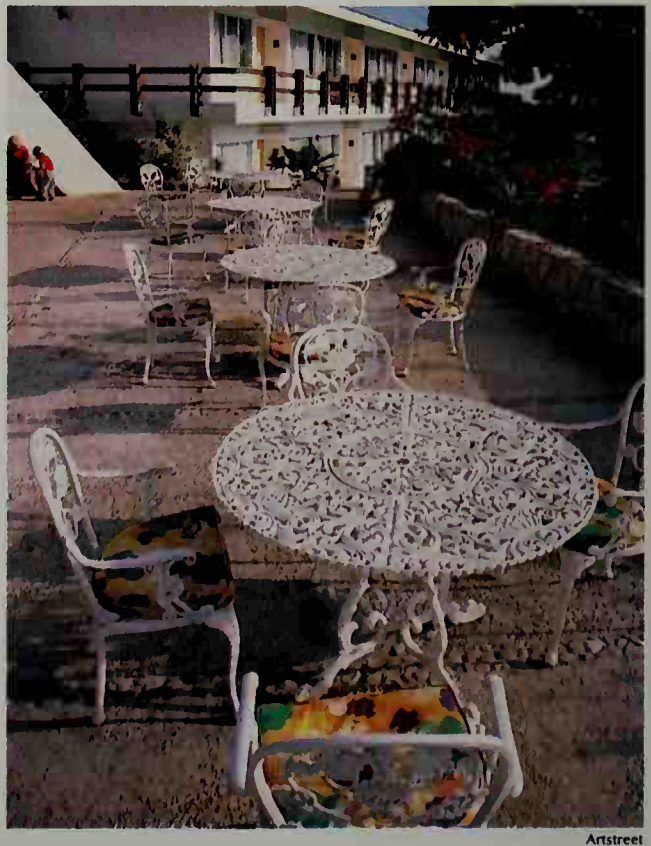
Dona Z. Meilach

See also **Folk Art** (picture: Metal weather vanes); **New Orleans** (picture: New Orleans' famous attractions).

Irony is a device used in speaking and writing to deliberately express ideas so they can be understood in two

© Christy Volpe from Marilyn Gartman

Lacy iron railings and pillars enclose the balconies of many old homes in the French Quarter of New Orleans. Much of this decorative ironwork dates back to the early 1800's.



Artstreet

Wrought-iron tables and chairs are popular patio furniture. The swirling floral patterns on the legs, table tops, and chair backs add an elegant touch to informal outdoor decor.

different ways. There are three basic kinds of irony: (1) verbal irony, (2) dramatic irony, and (3) irony of fate.

Verbal irony is used to strengthen a statement by forcing the listener or reader to seek its true meaning. Suppose, for example, that a ballet dancer trips several times and her choreographer says, "You were very graceful!" The choreographer is using irony and actually means the opposite of what the words seem to say.

Dramatic irony occurs in drama or fiction when a character—or the audience or reader—knows something that the other characters do not know. In the Greek tragedy *Oedipus Rex* by Sophocles, Oedipus kills a man. He does not know that the man is Laius, his father. Oedipus puts a curse on the slayer of Laius. The irony is that Oedipus has unknowingly cursed himself.

Irony of fate occurs in a play or story when events work out contrary to expectations. Suppose that the characters are preparing a party for a returning soldier. But the soldier has just been killed in an accident on his way home. The irony comes from the contrast between the characters' expectations and the actual situation.

Irony was a favored device in literary criticism of the 1900's. It was used especially for distinguishing among the voices, beliefs, and actions of authors, narrators or speakers, characters, and readers. William H. Epstein

Iroquois Indians, *IHR uh kwoy,* formed a federation of tribes that once occupied upper New York state. From east to west, the tribes included the Mohawk, Oneida, Onondaga, Cayuga, and Seneca. The Iroquois called themselves the *Haudenosaunee.* This name refers to their dwellings and means *we longhouse builders.* The Iroquois tribes became famous as the *Five Nations,* or *Iroquois Longhouse.* The federation was the most efficient North American Indian organization.

The federation was formed by the early 1600's. About 1722, the Tuscarora Indians joined the Iroquois League, which then became known as the *Six Nations.* The confederation of states that became the United States of America may have been patterned after the league.

Women played an important part in Iroquois life. They nominated members of the tribal council and removed them from office if they misbehaved. Each tribe sent a given number of its leaders to the great federation council. The language of the Iroquois belonged to a large language family, the *Iroquoian.*

The Iroquois were brave and skillful warriors. They obtained firearms from the Dutch in the early 1600's, and soon subdued all the Indians from the St. Lawrence River to Tennessee and from Maine to Michigan. They controlled the fur trade in their territory and boat travel on the Great Lakes.

Some historians say that if the French had been able to make allies of the Iroquois, they might have won the French and Indian wars, and the United States might have become French. But the Iroquois, under such leaders as Joseph Brant, sided with the British. Later, however, the league broke up over the question of whether to join the British or the Americans during the Revolutionary War in America (1775-1783). All of the Indian tribes except the Oneida and Tuscarora took the British side. In 1779, General John Sullivan, under George Washington's orders, took revenge on the Indians by destroying their villages.

Most of the Cayuga and Mohawk and some of the Tuscarora moved to reservations in Canada. A majority of the Oneida moved to Wisconsin, and a few Seneca went to live in Pennsylvania and Oklahoma. The Onondaga and most of the Seneca and Tuscarora remained on five reservations in New York state.

According to the 2000 U.S. census, about 45,000 people belong to the Iroquois tribes. The headquarters of the Iroquois confederacy are at Onondaga Reservation, south of Syracuse, New York. This reservation contains the council houses, the home of the chief, and the grave of Handsome Lake, a Seneca prophet. Robert E. Powless

Related articles in *World Book* include:
Brant, Joseph
Cayuga Indians
Handsome Lake
Hiawatha
Mohawk Indians
Parker, Ely Samuel
Red Jacket
Seneca Indians

Irradiation, *ih RAY dee AY shuhn,* is the exposing of matter to radiation, usually for the purpose of producing a specific biological, chemical, or physical change. The radiation consists of high-energy particles or *electromagnetic waves* (related patterns of electric and magnetic force). The high-energy particles include individual alpha particles, electrons and neutrons released by radioactive substances, and beams of particles expelled from *particle accelerators* (see Particle accelerator). The electromagnetic waves are chiefly in the form of gamma rays, ultraviolet rays, and X rays.

When high-energy particles or rays penetrate matter, they ionize it. The resulting electrically charged atoms, or *ions,* combine to form new chemical compounds or altered molecular structures. For example, complex compounds, such as ethane (C_2H_6) and propane (C_3H_8), are produced from the simple gas methane (CH_4) by exposing it to high-energy electrons or gamma rays. Subjecting living cells to ionizing radiation can disrupt their normal chemical activity and kill them.

Irradiation has many practical applications. It can be used to prepare industrial chemicals and to cure certain paints that would be damaged by ordinary heat treatment. Irradiation is effective in killing bacteria. Thus, it is used in food preservation and for sterilizing surgical supplies. Cancer cells can be destroyed by carefully controlled irradiation. But serious biological damage and even death can result from excessive exposure to radiation. Also, genes damaged by radiation may transmit undesirable traits to offspring. John W. Poston, Sr.

See also Radiation.

Irrational number. See Rational number.

Irrawaddy River, *IHR uh WAH dee,* also spelled *Irawadi,* is the chief river of Myanmar. It flows about 1,300 miles (2,100 kilometers) south through some of the most colorful scenery in the country. The Irrawaddy rises in a high region of evergreen forests in northern Myanmar. It flows through a thickly populated area to the broad rice fields of the coast. There, the Irrawaddy enters the Bay of Bengal through many mouths that form a delta of rich farmland.

The banks of the Irrawaddy River have been diked for about 100 miles (160 kilometers) inland to protect the countryside from floods. The city of Yangon lies near the Irrawaddy River. Small steamers can sail up the river as far as Bhamo, some 870 miles (1,400 kilometers) inland.

H. J. McPherson

See also Myanmar (map; picture: Rice fields).

Arizona Photographic Assoc.

An irrigation canal carries water through the desert to farms near Yuma, Arizona. Irrigation has enabled large desert areas in the southwestern United States to be turned into productive farmland.

Irrigation is the watering of land by artificial methods. It provides water for plant growth in areas that have long periods of little or no rainfall. The water used for irrigation is taken from lakes, rivers, streams, and wells.

Irrigation is used chiefly in three types of climates. In desert regions, such as Egypt and the southwestern United States, farming would be impossible without irrigation. In regions with seasonal rainfall, such as California and Italy, irrigation makes farming possible even during dry months. In moist regions, such as the Eastern United States and western Europe, irrigation maintains crops during periods of drought.

Throughout the world, over 550 million acres (220 million hectares) of land are under irrigation. This includes over 50 million acres (20 million hectares) in the United States and about 1 $\frac{3}{4}$ million acres (700,000 hectares) in Canada.

The amount of water needed for farming varies with the type of crop and the climate. For example, rice requires more water than does cotton. Wheat grown in a warm climate needs more water than wheat that grows in a cool climate. Any farmland must receive enough water to allow both for plant growth and for the evaporation of water from the soil.

In some countries, more water is used for irrigation than for any other purpose. Irrigation accounts for about one-third of the water used in the United States. As the world's population grows, the demand for water increases steadily. More and more people need water in their homes, and industry must have additional water as production rises. Steps have been taken to ration water in areas where the demand for it exceeds the supply. In the western United States, for example, the government rations water from the Colorado River to various states.

Delmar D. Fangmeier, the contributor of this article, is Professor Emeritus of Agricultural and Biosystems Engineering at the University of Arizona.

Sources of irrigation water

Irrigation requires large supplies of *fresh* (unsalty) water. The two main sources of fresh water are *surface water* and *ground water*.

Surface water is water on the surface of the earth, such as in streams, rivers, and lakes. It is the chief source of water used for irrigation. Surface water comes mostly from rain and snow. Rain water flows from land into streams and rivers. Great quantities of snow accumulate on highlands and mountains during winter. In spring, the snow melts and runs off into surface waters.

In many parts of the world, engineers build dams across rivers to store water in artificial lakes. These lakes serve as reservoirs that hold water until it is needed for irrigation or some other purpose. A modern reservoir can hold a tremendous amount of water. For example, Franklin D. Roosevelt Lake, the reservoir on the Columbia River behind Grand Coulee Dam in Washington, can store about 9 $\frac{1}{2}$ million acre-feet (11.8 billion cubic meters) of water. An acre-foot equals the volume of a container that is 1 foot (0.3 meter) high and has a base of 1 acre (0.4 hectare) in area.

Ground water is stored beneath the earth's surface in spaces between rocks, grains of sand, and other substances in soil. Water fills these spaces as it moves down through the soil. The water eventually reaches a layer of rock or of a soil material that it cannot penetrate. The ground above this layer becomes a saturated area called an *aquifer*. Water in aquifers may require thousands of years to accumulate. Many of the best supplies of ground water are near rivers. Water from a river seeps into the ground and then into an aquifer.

Other sources contribute little to the total amount of water used for irrigation. In the Negev Desert of Israel,

WORLD BOOK map

The Imperial Valley, an irrigated region in the desert of south-central California, is one of the richest farming areas in the United States. The All-American Canal carries water to the valley from the Imperial Reservoir. A network of smaller canals distributes the water throughout the region.

farmers conserve dew and use it to irrigate their fields. In some other areas, farmers use water from sewage treatment plants to irrigate certain crops. Ocean water can be used for irrigation if the salt is removed. However, the cost of removing the salt and pumping the water inland is extremely high.

Bringing irrigation water to farms

Irrigation requires a method of transporting water from the supply source to a farm. Most farms obtain surface water by means of a network of canals. A large canal carries the water from the supply source to smaller canals called *laterals.* The laterals are connected to ditches that take the water to the crops. If a farm lies at a lower elevation than the supply source, the water flows to the canals by gravity. If the farm lies at a higher elevation than the source, the water must be pumped up to the canals.

Ground water is pumped to the surface from wells dug below the *water table,* the top of an aquifer. If possible, an irrigation well is dug on or near the farm it serves. The pump in the well lifts the water into a ditch or pipe that carries it to the crops. If the well is far from the farm, a system of canals or pipes is needed to bring the water to the crops.

Irrigation water may be lost before it reaches crops. For example, reservoirs lose water through evaporation. The greater the surface area of the reservoir, the more water is lost. The amount of water lost through evaporation can be reduced by building deep reservoirs that have small surface areas.

In regions with porous soils, water may be lost through *seepage.* Seepage occurs when water leaks from the bottom or sides of reservoirs and irrigation channels. Seepage from reservoirs can be controlled by lining a reservoir with a layer of fine soil that water does not easily penetrate. Engineers try to build reservoirs in places where the soil does not allow much seepage. Seepage from irrigation channels can be prevented by lining the canals or streams with a watertight material, such as asphalt or concrete.

Evaporation of water through the leaves of plants is called *transpiration.* Plants absorb water through their roots and lose it through transpiration. The transpiration of weeds growing in or near irrigation channels may cause great loss of water. Some loss from transpiration can be avoided by lining the channels with a watertight material to prevent weed growth along the channels.

Applying irrigation water to crops

Proper application of irrigation water requires considerable skill. A farmer must know when to irrigate different crops and how much water to use. In general, plants need irrigation only after they have used up most of the moisture in the soil. But a farmer also must consider other factors before irrigating. These include the amount of water available for irrigation, the type of crop, the distance of the water table from the surface, and the ability of the soil to hold water.

There are four general methods of applying irrigation water: (1) surface irrigation, (2) sprinkler irrigation, (3) trickle irrigation, and (4) subirrigation.

Surface irrigation, the most common method of irrigation, is used on about 60 per cent of the irrigated land in the United States. In surface irrigation, the farmer runs water over the surface of the field. There are two chief types of surface irrigation, *flood irrigation* and *furrow irrigation.*

Flood irrigation covers the entire surface of a field with water, which soaks into the soil. Small soil walls called *dikes* or *levees* hold the water on the field. On many farms, the dikes divide the field into sections. The farmer floods each section individually.

Flood irrigation works best on level or gently rolling

Shostal

Flood irrigation covers a field with water. Dirt mounds called *dikes* hold the water on the field. The workers shown above are transplanting rice in a flooded field in India.

Shostal

Furrow irrigation uses narrow ditches called *furrows* to carry water between rows of crops. The water flows through a pipe, *foreground,* and pours out through openings into the furrows.

Comstock, Inc.

Sprinkler irrigation spreads water in the form of mist over a field. The sprinkling system shown above has an engine and wheels and moves across the field under its own power.

© Tim McCabe, Taurus

Trickle irrigation provides water through plastic tubes. The water trickles out of tiny openings in the tubes into the soil. This photograph shows trickle irrigation of a cotton crop.

terrain where water is plentiful. The soil should be deep and able to hold a large amount of water. This method is generally used on crops of alfalfa and rice, wheat, and other grains. Rice grown in *paddies* (fields enclosed by dikes) is flooded continuously. Other crops are flooded for only a few hours at a time.

Furrow irrigation. Most crops that are planted in rows, such as corn, cotton, and potatoes, are irrigated by water from narrow ditches called *furrows.* In this method, rows of furrows are dug across a field. The farmer plants seeds in the ridges between the furrows. As water enters the furrows, it seeps into the ridges. Furrow irrigation is used on many soils and terrains.

Sprinkler irrigation provides water through pipes that lie on or are mounted above the ground. This method became popular with the development of inexpensive plastic and aluminum pipe in the 1940's.

In sprinkler irrigation, a pump forces water through a pipe to nozzles called *sprinkler heads.* The sprinkler heads distribute water to the crops in a spray or mist. In most cases, the farmer can move the pipe to irrigate the entire field. *Self-propelled sprinkling systems* have an engine and wheels built into the sprinkler unit. These systems move across a farm under their own power.

Sprinkler irrigation can be used on most crops and soils and on level or rolling terrain. It provides an efficient way to irrigate farms with a small water supply. Sprinkling systems may require large amounts of energy, and so their use is limited to areas with ample energy supplies. But some systems use low-pressure sprinkler heads, which require much less energy.

Trickle irrigation, also called *drip irrigation,* furnishes water through plastic tubes that lie on or under the ground. The tubes have small openings called *emit-*

ters at points corresponding to the location of the plants. As water flows through the tubes, it trickles out of the emitters into the soil. Only the soil directly around the plants receives moisture. As a result, trickle irrigation wastes little water.

Trickle irrigation can be used on all crops, soils, and terrains. Its efficient use of water makes it ideal for areas with small water supplies. But the high cost of installing and maintaining trickle irrigation makes it impractical for most farming. The method generally is used only for high-value crops, such as fruits and vegetables.

Subirrigation applies water from beneath the roots of plants. The water comes from ditches or underground pipes, and the surface of the ground remains dry. Subirrigation requires a watertight layer of soil or rock below the plant roots. Water collects above this layer and moistens the roots.

Providing artificial drainage

Under many conditions, water drains from soil naturally. However, a flood or heavy rain can cause excess water to accumulate in soil. An efficient water management system provides for the artificial drainage of excess water.

When land receives too much water, the water table rises almost to the level of the ground surface, and the soil becomes saturated. Most plants need air in the soil, as well as water. *Pores* (air spaces) in soil normally provide air. However, the pores of saturated soil are filled with water.

Farmers remove water from soil through underground drains or by means of ditches. Underground drains are made of pipe or hollow tile. They have numerous openings that allow water to enter but keep soil out. Drainage ditches cost less to build than underground drains, but they are expensive to maintain. They also interfere with the movement of workers and machines. Some drainage systems return water to irrigation channels for reuse.

Most irrigation water contains small amounts of soluble salts. These salts remain in the soil, whether crops use the water or it evaporates from the surface of the ground. Excess salts can reduce or prevent plant growth. For example, certain salts react chemically with soil particles to change the structure of soil. Such a change can hinder the movement of air and water through the soil. In addition, salts injure some plants and compete with roots for water in soil.

Farmers remove excess salts from soil by *leaching* (flushing) the soil with water. Leaching applies enough water to soil to move salts away from the roots of plants. But if the land does not have a good drainage system, leaching may result in saturated soil. In addition, inadequate leaching may not remove enough salt. In the Southwestern United States, some land that has been irrigated is now of limited use for agriculture because of a build-up of salt.

History

Ancient civilizations developed along rivers that supplied water for farming. As early as 5000 B.C., the Egyptians cultivated land made fertile by the floodwaters of the Nile River. By about 3000 B.C., they had built an elaborate canal system that carried water from the Nile to their fields. Large irrigation systems also had been constructed by then in China, India, and southwest Asia.

Indians in Mexico and Peru used water from streams to grow corn as early as 800 B.C. When the Spaniards arrived in those countries during the A.D. 1500's, they found great civilizations based on irrigated agriculture. Archaeologists have discovered evidence of early irrigation ditches in the Southwestern United States. These ditches date from before the 600's. Scientists estimate that Indians of that period irrigated thousands of acres or hectares of land in what became central Arizona.

Modern irrigation methods in the United States began in the 1840's. At that time, Mormon settlers built a system of irrigation canals in the Salt Lake Valley of present-day Utah. During the gold rush in California in the late 1840's and the 1850's, the pioneers dug many ditches to wash gold from streams. Some of these ditches later served as aids to irrigation.

The Reclamation Act of 1902 authorized the government to build irrigation systems in many Western states. Irrigation has expanded rapidly in the West ever since. The Bureau of Reclamation, an agency of the United States Department of the Interior, has provided much of the planning and funds for major irrigation projects. Such projects as the Hoover Dam on the Colorado River have helped transform great expanses of wasteland into productive farmland. Delmar D. Fangmeier

Related articles in *World Book* include:

Archimedean screw
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Dam
Drainage
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Egypt (Agriculture)
Inca (Food, clothing, and shelter)
Reclamation, Bureau of
Reservoir
Water (Water for irrigation)
World (picture: Making barren land productive)

IRS. See Internal Revenue Service.

Irving, John (1942-), is an American novelist who has gained enormous popularity with readers and acclaim from critics. A skillful storyteller, Irving emphasizes eccentric characters, lively episodes and adventures, and a sentimental vision of humanity.

John Winslow Irving was born in Exeter, N.H. He studied at the University of Vienna, Austria, in 1963 and 1964, and Vienna became an important backdrop to several of his novels. Irving secured his reputation with his fourth novel, *The World According to Garp* (1978). The book deals with a well-meaning writer who pits the virtues of love and family against a series of bizarre catastrophes and modern sexual confusions.

Irving's first novel was *Setting Free the Bears* (1968), a story about two young men on a motorcycle trip through Austria. *The Water-Method Man* (1972) concerns a college graduate student trying to handle a complicated sex life while translating a Norse epic for his doctoral dissertation. *The 158-Pound Marriage* (1974) is a kind of moral fable about marital infidelity. *The Hotel New Hampshire* (1981) tells about a family seeking sanctuary in their hotel from a series of personal crises. *The Cider House Rules* (1985) is set in Maine and focuses on the issue of abortion. *A Prayer for Owen Meany* (1989) is a story about an odd little hero who claims to be "God's instrument" in the world. *A Son of the Circus* (1994) is a sprawling novel set in India. Irving's short stories were collected in *Trying to Save Piggy Sneed* (1993).

Arthur M. Saltzman

Irving, Washington (1783-1859), was one of the first American authors to win recognition in Europe as well as the United States. He became famous for his humorous stories and for his satirical essays, which poked fun at New York City's fashionable society. At various times, Irving also was a lawyer, a businessman, and a United States diplomat to England and Spain.

Library of Congress

Washington Irving

Irving's best-known works include two short stories, "Rip Van Winkle" and "The Legend of Sleepy Hollow." In "Rip Van Winkle," the title character falls asleep for 20 years and awakens to find everything different. "The Legend of Sleepy Hollow" tells about Ichabod Crane, a poor schoolmaster, and his encounter with a headless horseman.

Irving lived during the period when the United States began to develop an artistic culture of its own. His literary achievements influenced other American writers and helped gain respect for American literature among critics in other countries.

Early career. Irving was born in New York City and attended school until he was nearly 15 years old. He later went to work in a law office to study law. Irving became interested in writing while in his teens, and his first published works appeared in 1802 and 1803. They were in the form of letters to the *Morning Chronicle,* a New York City newspaper edited by his brother Peter. The letters ridiculed New York society, and they made Irving known among New Yorkers. In 1807 and 1808, he helped his brother William and James K. Paulding, William's brother-in-law, write satirical essays for their magazine, *Salmagundi.*

Irving eventually became a lawyer, but his interest in the law gave way to his love for writing. He abandoned his law practice in 1809, and his first book was published that same year. It was called *A History of New York from the Beginning of the World to the End of the Dutch Dynasty.* Irving wrote this book under the name of Diedrich Knickerbocker, an eccentric man who became one of the author's most popular characters. *Knickerbocker's History of New York,* as the book is usually known, is a boisterous, satirical account of the state during its colonial past and in Irving's day.

Many prominent New York families were offended by the history because it ridiculed their ancestors. But the book was a major comic triumph. It shows Irving's knowledge of history and his familiarity with the works of earlier writers of comic literature. The Knickerbocker tales are a beloved part of New York folklore.

Years in Europe. In 1810, Irving joined his family's hardware company. He went to England in 1815 to help run a branch of the business there. The company failed in 1818, freeing Irving to dedicate himself entirely to literature.

While in England, Irving wrote *The Sketch Book of Geoffrey Crayon, Gent.* (1819-1820). This book consists of a series of essays, stories, and other short pieces about the United States and England. *The Sketch Book,* as it is commonly called, won Irving—and American literature—the respect of European critics. The book includes Irving's two most important works, "Rip Van Winkle" and "The Legend of Sleepy Hollow." With these tales, Irving reached the peak of his achievement in humorous writing. The tales also marked the acceptance of the short story as an important literary form in America. *Bracebridge Hall* (1822), which followed *The Sketch Book,* also emphasizes British settings but was a less successful book.

Irving stayed in Europe until 1832. He traveled to many countries and was influenced by European traditions and by European authors, especially Sir Walter Scott. The writing in much of *The Sketch Book* and in many of Irving's later works shows this European influence. For example, the narrators in these works sound much more polite and refined than the ones in his earlier writings. Also, the style in some of the later works seems overly sentimental. It lacks the originality and power that Irving had shown earlier.

Irving's stay in Europe also affected his selection of subjects. "Rip Van Winkle" and "The Legend of Sleepy Hollow," though set in America, had been based on German folk tales. During his travels, Irving's interest in folklore increased, and he collected tales in each country he visited. *Tales of a Traveller* (1824) chiefly explores German and Italian themes.

In 1826, Irving became a U.S. diplomat in Spain and began to study and write about Spanish themes. His works from this period include *History of the Life and Voyages of Christopher Columbus* (1828), *The Conquest of Granada* (1829), and *The Alhambra* (1832). In 1829, Irving joined the U.S. diplomatic staff in London.

Later writings. Irving returned to New York in 1832. Later that year, he set out on a visit to the Western frontier. Irving described this trip in *A Tour on the Prairies,* the first in a series of books called *The Crayon Miscellany* (1835).

Irving settled at his home, Sunnyside, near Tarrytown, N.Y., and turned from fiction to writing history and biography. In 1842, he was appointed United States minister to Spain. He served there for four years and then returned to Sunnyside, where he lived for the rest of his life. In 1859, Irving completed *The Life of George Washington,* an impressive five-volume biography. He died shortly after finishing the last volume.

Irving's place in literature. During his lifetime, Irving was admired as a leading American author. Today, he is not considered the creative equal of such other major writers of his time as James Fenimore Cooper, Nathaniel Hawthorne, Herman Melville, and Edgar Allan Poe. However, Irving's style and choice of subjects greatly influenced those and other writers. For example, his imaginative treatment of historical themes and his use of folklore and other elements of romanticism promoted the romantic literary movement in the United States.

Irving's early works set an example for humorous writing, which later became an important part of American literature. In addition, Irving helped establish the short story as a popular literary form in the United States.

Sargent Bush, Jr.

See also **Rip Van Winkle.**

Irvington, New Jersey (pop. 60,695), is an industrial center on the Elizabeth River, west of Newark (see New Jersey [political map]). Its factories produce a wide variety of products, including collapsible tubes, jewelry, machinery, plastics, tools, and toys.

Irvington was first called Camptown. The name was changed in 1852 to honor the American writer Washington Irving. It is a township with a mayor-council government. Peter O. Wacker

Irwin, James Benson (1930-1991), a United States astronaut, piloted the lunar module *Falcon* on the Apollo 15 mission. In July 1971, this mission made the fourth astronaut landing on the moon.

Irwin and astronaut David R. Scott spent nearly 67 hours on the moon. Their explorations featured the first use of a vehicle called the *lunar roving vehicle* or *lunar rover.* Irwin and Scott made three trips in the lunar rover in the area of the Hadley Rille. They also assembled an automatic scientific station to transmit information back to earth. The third crew member, Alfred M. Worden, remained in lunar orbit.

NASA

James B. Irwin

Irwin was born in Pittsburgh, Pennsylvania. After graduating from the U.S. Naval Academy in 1951, he entered the Air Force. In 1957, Irwin earned master's degrees in aeronautical engineering and instrumentation engineering at the University of Michigan. He graduated from the Air Force Experimental Test Pilot School in 1961 and from the Aerospace Research Pilot School in 1963. Irwin served as an astronaut from 1966 to 1972, when he resigned. He became a member of an evangelistic group called High Flight. James R. Hansen

Isaac, *EYE zuhk,* the second of the Hebrew patriarchs, was the son of Abraham and his wife Sarah (see **Abraham; Ishmael**). The prediction of his birth caused amusement because his parents were old, and God gave him the name *Isaac,* which means *one laughs.*

Isaac was the object of his father's special love because he was a child of divine promise. God's command to Abraham to sacrifice Isaac on Mount Moriah (Genesis 22) was the greatest test of Abraham's faith. The account of this episode is one of the most dramatic stories in the Book of Genesis.

Another story tells how Abraham sent his servant to his old home in Mesopotamia to get a wife for Isaac (Genesis 24). God led the servant to Rebecca. Rebecca went with the servant to Canaan (later called Palestine), and became the wife of Isaac. She was childless for 20 years, and then gave birth to twins, Esau and Jacob (see **Esau; Jacob**). When Isaac became blind and feeble from old age, he was eager to give his blessing and inheritance to Esau. Rebecca's success in stealing the blessing for Jacob by deceit resulted in a family quarrel. Jacob fled to Mesopotamia. However, Isaac's sons were reconciled before his death (Genesis 33). Carole R. Fontaine

Isabella I (1451-1504), queen of Castile and Aragon, played one of the most important parts in the history of Spain. She married Ferdinand of Aragon in 1469. The marriage led to the union of Spain's largest kingdoms, Castile and Aragon, in 1479 and thus laid the foundations for Spain's future greatness (see **Ferdinand V**).

Oil painting on wood (1497) attributed to Bartolomé Bermejo; Patrimonio Nacional, Madrid, Spain (Ampliaciones y Reproducciones MAS)

Queen Isabella I of Spain

During the reign of Isabella and Ferdinand, new roads were built and the coinage was made standard. Spanish law was codified, and the rulers took over the administration of justice. They reduced the powers of the nobles. Isabella and Ferdinand made war on the Muslims, who held part of southern Spain. They captured the Muslim stronghold of Granada in 1492. That same year, all Jews were ordered to become Christians or leave Spain.

Isabella was one of the few people who saw merit in the plan of Christopher Columbus to find the Indies by sailing west. Her support of Columbus gave Spain its first claims in America (see **Columbus, Christopher**). This led to the beginning of the Spanish Empire in the Western Hemisphere.

Carla Rahn Phillips and William D. Phillips, Jr.

Isaiah, *eye ZAY uh,* **Book of,** is a book of the Bible that is named for the Hebrew prophet Isaiah. It is the

Detail of a fresco (1512) by Michelangelo on the ceiling of the Sistine Chapel, Vatican City; SCALA

Isaiah was an ancient Hebrew prophet who lived in Palestine during the 700's B.C. Scholars believe his sayings appear in the first 39 chapters of the Book of Isaiah in the Old Testament.

longest of the group of Biblical books known as the *Prophets.* Many scholars believe the book was written by a number of authors from the 700's to the 500's B.C.

The first 39 chapters, often called *First Isaiah,* consist of the prophecies of Isaiah of Judah, who lived in Jerusalem during the 700's B.C. Most of his prophecies occurred during the reign of King Hezekiah. First Isaiah told the Jews to have faith and to trust only in God, rather than in political or military actions. The prophet stressed the idea that God saves and protects the faithful and punishes His enemies. This section also taught that God's power is universal, not limited to the Jews.

Chapters 40-55 are often called *Second,* or *Deutero, Isaiah.* The writer of these chapters probably lived during a period of captivity called the Babylonian Exile, which began in 587 or 586 B.C. During this time, many Jews were held captive in Babylon. Second Isaiah offered hope and consolation by correctly prophesying the Jews' return to Jerusalem in 538 B.C. The author of this section introduced the idea of the *suffering servant.* The servant has been interpreted as an individual and as the entire Jewish people. According to Second Isaiah, the servant will be ignored and abused, but his message of justice and truth will finally triumph.

Some scholars believe that a third prophet, or a group of prophets, wrote chapters 56-66. This section is sometimes called *Third,* or *Trito, Isaiah.* It was written after the return from the exile in Babylon and reflects religious conditions in Jerusalem at this time. Third Isaiah provides instructions to help the Jews reestablish their faith and procedures for worship. Eric M. Meyers

Iscariot, Judas. See Judas Iscariot.

Isfahan, *IHS fuh HAHN* (pop. 1,266,072), is one of the largest cities in Iran. It lies in west-central Iran, along the Zayandeh (Zaindeh) River. For the location of Isfahan, see **Iran** (map).

Isfahan, also spelled Esfahan, is famous for its many *mosques* (Muslim houses of worship) and other examples of Islamic architecture. The center of the city is the Meidan-e-Imam (Imam Square). The many beautiful structures around the square include the magnificent blue-domed Masjid-e-Imam (Imam Mosque), an outstanding example of medieval Islamic architecture (see **Iran** [picture: A beautiful blue-domed mosque]). The Shaykh Lutfullah Mosque also stands along the square. Its remarkable dome and interior are decorated with baked clay tiles in elaborate designs.

Industrial products of Isfahan include textiles and steel. At a huge covered bazaar near the square, tradespeople sell handicrafts, rugs, and other articles.

Isfahan dates from ancient times. Little is known of its history before the Muslim Arabs conquered Persia (now Iran) in the mid-600's. Shah Abbas ruled Persia from Isfahan from 1598 to 1629. He built mosques, palaces, and public buildings, and turned Isfahan into the beautiful city it is today. Michel Le Gall

Isherwood, Christopher (1904-1986), was an English-born novelist and dramatist best known for his descriptions of the petty boredom and aimless quality of life in Europe in the 1930's. His most representative works, including *The Last of Mr. Norris* (1935) and *Goodbye to Berlin* (1939), present trivial characters caught up in the great crises of the modern age. Lacking any moral sense, the characters react to crisis with laughter and bluster, until the rise of the Nazis wipes out their world. Isherwood's style shows a strong sense of form and movement and facility with words.

Isherwood was born in Cheshire, England. He moved to the United States in 1939 and became a U.S. citizen in 1946. Isherwood collaborated with poet W. H. Auden on several plays, including *The Dog Beneath the Skin* (1935) and *Ascent of F6* (1937). Isherwood also wrote an autobiography, *Lions and Shadows* (1938). Michael Seidel

Ishmael, *IHSH mee uhl,* in the Old Testament Book of Genesis, was the elder son of Abraham. Ishmael's mother was Hagar, an Egyptian serving-maid. Abraham's wife, Sarah, had given Hagar to Abraham because Sarah despaired of ever becoming a mother. But later, Sarah bore Abraham a son, Isaac, and God said that he, instead of Ishmael, should be Abraham's heir (see **Isaac**).

When Ishmael and Isaac were still young children, Sarah pressured Abraham to send Ishmael and Hagar away. Hagar and Ishmael wandered in the desert and would have died of thirst had not God directed them to a well. Ishmael became a mighty warrior and was the father of 12 sons. The Arabs honor him, along with Abraham, as their ancestor. J. Maxwell Miller

Isinglass, *EYE zihng GLAS,* is the purest form of animal gelatin. It is a tough, semitransparent silvery-white substance which is prepared from the *sounds* (air or swim bladders) of certain fish. The best-quality isinglass comes from the Russian sturgeon. Isinglass also comes from carp, catfish, cod, hake, and other kinds of fish.

To prepare isinglass, manufacturers take the bladder from the fish, and wash it in cold water. Then, they take off the black outer skin. Next, they wash the remaining part and spread it on a tray to dry. After it is dry, workers dampen the bladder in warm water, and take out the inner skin by rubbing and beating. Then, they pass it between rollers, which reduce it to a thin, partly transparent ribbon which looks a little like watered silk.

Beverage makers use isinglass to remove unwanted particles from fruit juices and alcoholic drinks. It is also used in the making of certain inks, cements, jams, jellies, and soups. George J. Flick, Jr.

Isis, *EYE sihs,* was the most popular goddess in ancient Egyptian mythology. People identified Isis with royal power because she was the wife and sister of Osiris, king of the underworld. The sky god Horus, in the form of the Egyptian king, was their son. Isis, Osiris, and Horus were honored in a myth about the glorification of Osiris as prince of the dead (see **Mythology** [The Osiris myth]). Egyptians believed they could become Osiris when they died. They worshiped Isis as the protector of the dead and also as the divine mother.

The earliest definite references to Isis were inscriptions found in pyramids built about 2350 B.C. Isis was originally a local goddess in the northern delta of the Nile, but her worship spread throughout Egypt and also became popular among Greeks and Romans.

Artists usually portrayed Isis in human form, often with the *hieroglyph* (symbol) for a seat or throne over her head (see **Mythology** [picture: Important divinities in Egyptian mythology]). Isis gradually merged with the cow goddess Hathor. After about 1500 B.C., Isis, like Hathor, was usually shown with horns and a solar disk above her head (see **Hieroglyphics** [picture: Egyptian hieroglyphics]). R. F. G. Sweet

Islam, *ihs LAHM,* is the name given to the religion preached by the Prophet Muhammad in the A.D. 600's. Islam is an Arabic word that means *surrender* or *submission.* God is called *Allah* (in Arabic, pronounced *ah LAH),* which means *The God.* A person who submits to Allah and follows the teachings of Islam is called a *Muslim.* This article discusses the beliefs and practices of Islam. For information about the history of Muslim people, including the history of their religion, see Muslims.

Muhammad was born about A.D. 570 in the Arabian city of Mecca. Muslims believe that in about 610, he began to receive revelations from Allah that were transmitted by the angel Gabriel. These revelations took place in the cities of Mecca and Medina over about a 22-year period. They were assembled in a book called the Quran (*ku RAHN),* sometimes spelled *Koran.* The Quran is the holy book of the Muslims, who believe it contains God's actual words. The Quran and the *Sunna (SOON uh),* the example of the words and practices of Muhammad, make up the foundation of Islamic law.

Islam is the world's second largest religion behind Christianity. Over 1.1 billion people follow Islam.Today, Muslims live in every country in the world. Although Islam began in Arabia, more than half of the world's Muslims live in South and Southeast Asia. The countries with the largest Muslim populations are Indonesia, India, Bangladesh, and Pakistan. About one-fourth of all Muslims live in the Middle East. They make up the majority of the population in the European country of Albania and nearly half the population in Bosnia-Herzegovina. Muslims rank as the second largest religious group in Belgium, France, and Germany. Several million Muslims live in the United States.

Teachings and practices

The central concept of Islam is *tawhid (taw HEED),* the oneness of God. For Muslims, there is one God who is the lord of the universe. People owe worship and obedience to God before any other thing. God is one, the creator, the all-knowing. In relations with humanity, God is the lawgiver, judge, and restorer of life after death.

Prophets. According to the Quran, God has provided guidance for human beings in the teachings of prophets, who have appeared in many nations throughout history. In Islam, prophets do not foretell the future. Instead, God selects the prophets to urge people to worship God alone and to teach them to live according to God's commandments. The Quran mentions 25 prophets by name. According to tradition, God chose thousands of prophets beginning with Adam, the first prophet in Islam, and ending with Muhammad, the final prophet. The Quran teaches that the Prophet Abraham was the first *monotheist* (believer in one God).

The most important type of prophet in Islam is the *rasul (rah SOOL),* which means *messenger.* A rasul is a person to whom God has revealed a book for the guidance of humanity. The messengers of God in Islam include Abraham, Moses, David, Jesus, and Muhammad.

Muslims believe children are born without sin and that all people can lead themselves to salvation once God has shown them the way. Believers in Islam achieve salvation by following the revealed books of God's messengers. Muslims believe in heaven and hell, where people go after death based on their actions during life.

The Sunna of Muhammad. In Islam, Muhammad is the final messenger of God, sent to confirm the authentic teachings of previous prophets. God also sent him to correct the alterations that followers of previous religions had introduced into God's original teachings. For Muslims, Muhammad's mission includes all humanity and is not limited to a specific region, group, or community. Therefore, his life serves as a model for all men and women. The example of Muhammad's sayings and acts, the Sunna, is presented in written collections called the *Hadith (hah DEETH).*

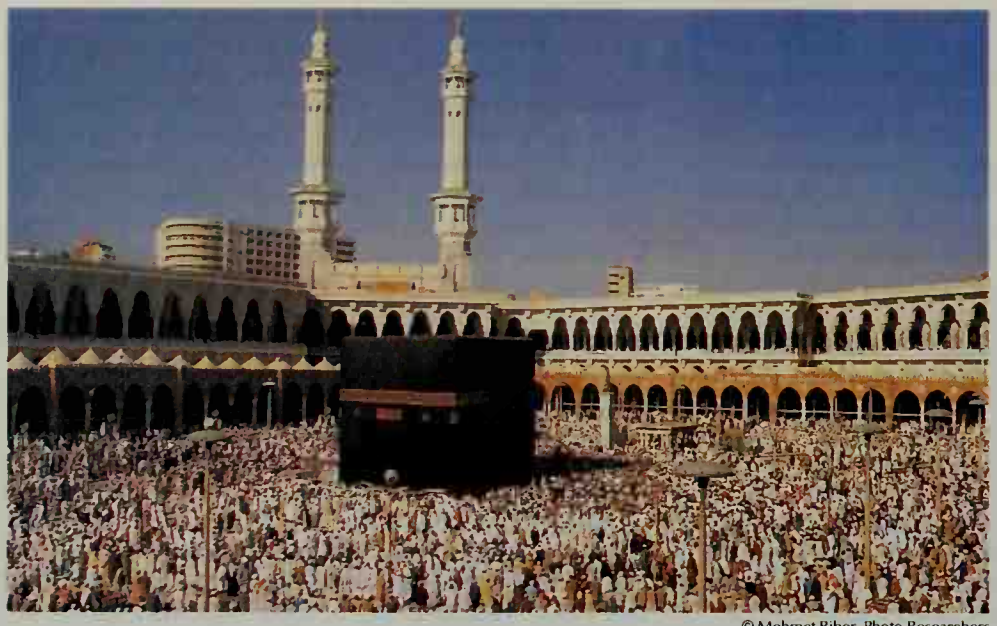
Muslims do not consider Islam to be a new religion. They believe its teachings contain the same message given to all prophets and messengers since the creation of Adam. Because they confirm all of these teachings as a whole, they do not like to be called *Muhammadans.*

The Five Pillars of Islam. Every action performed in obedience to God is considered an act of worship in Islam. Most devout Muslims take care in their daily lives to respect their parents and elders, to be kind to animals and human beings, and to do their daily tasks to the best of their ability. The formal acts of worship called the Five Pillars of Islam provide the framework for all aspects of a Muslim's life. The pillars consist of (1) *shahada,* (2) prayer, (3) almsgiving, (4) fasting, and (5) pilgrimage.

Shahada is the first pillar and is considered the basis of all other pillars of the faith. *Shahada* (*shuh HAHD uh*) is an Arabic word that means *an act of bearing witness.* It consists of two statements: "I bear witness that there is no God but Allah," and "I bear witness that Muhammad is the Messenger of Allah." The first statement declares that there is only one God and that God alone is worthy of worship. The second statement says that Muhammad is God's messenger. For Muslims, the second statement also includes a declaration of belief in Muhammad's interpretation of Islam, as expressed in the Sunna.

Prayer. Muslims are required to pray five times a day—just before dawn, at midday, in midafternoon, just after sunset, and at night. Prayer, called *salat (suh LAHT),* is the most important demonstration of a Muslim's devotion to God. Muslims believe that prayer reinforces belief in Islam because it reduces the likelihood of disobeying God by committing sins. A prayer's timing is determined by the movement of the sun. A crier called a *muezzin (moo EHZ ihn)* makes the call to prayer. If the prayer is performed in a *mosque (masjid* in Arabic, meaning *house of worship),* the muezzin traditionally calls worshipers from a tower called a *minaret.* Before making their prayers, Muslims must wash their hands, their face, parts of their arms and head, and their feet in a ritual manner.

The physical movements of the salat symbolize the believers' submission to God. When praying, Muslims stand facing the holy city of Mecca in Saudi Arabia. Raising their hands to their ears, they say in Arabic "God is greatest." They then recite the opening passage of the Quran, known as the Fatiha *(FAH tee hah),* followed by another verse from the Quran. After reciting these verses, they again say "God is greatest" and bow from the waist, praising God. After returning to an upright position, they say "God is greatest" a third time and fall to their knees, touching the floor with their foreheads. In this face-down position, they again praise God. After sitting back on their heels and asking God for forgiveness,



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Muslim pilgrims pray at the Kaaba, the holiest shrine of Islam. The Kaaba is an empty cube-shaped building that stands in the center of the Great Mosque in the city of Mecca, Saudi Arabia. According to Islamic law, all adult Muslims must, if possible, make at least one pilgrimage to Mecca during their lifetime.

worshipers kneel with their faces down one more time and then stand, saying "God is greatest" before each new position.

Each cycle of the prayer is called a *raka (RAHK uh),* which means *bowing* in Arabic. One cycle includes the first Quran recitation, the bow, kneeling face down twice, sitting, and standing up. After the final cycle, worshipers offer a peace greeting. Depending on the time of day, the salat may have two to four cycles. On Fridays, Muslims gather at midday to pray as a group. Before the prayer, a religious leader called an *imam (ih MAHM)* recites two short sermons. Typically, men pray at the front of the group and women pray in a separate section behind or beside them.

Almsgiving is required as a way of assisting the poor. The Arabic term for almsgiving is *zakat,* which means *purification.* Muslims "purify" their wealth by giving a certain percentage of it to the needy and recognizing that all things ultimately belong to God. Zakat is paid once a year, in the form of a tax. Most zakat donations go to mosques, Islamic centers, or welfare organizations. Some Muslims supplement zakat with a voluntary form of giving called *sadaqa (SAH dah kah),* which means *sincere gift* in Arabic.

Fasting. Every Muslim must fast in the month of Ramadan *(RAHM uh DAHN),* the ninth month of the Islamic calendar. The Islamic calendar is lunar, so each month follows the phases of the moon and lasts 29 or 30 days. As a result, Ramadan falls at different seasons of the year. Muslims believe that the first verses of the Quran were revealed to Muhammad during Ramadan about A.D. 610.

The Quran instructs Muslims to fast from dawn to sunset during Ramadan. While fasting, Muslims do not eat any food, drink any beverages, smoke, or engage in sexual relations during daylight hours. At night, they may eat, drink, and resume other normal activities. Muslims fast to practice spiritual reflection, self-restraint, concern for others, and obedience to God. Alms are normally given to the poor at the end of the fast. Because fasting can be physically demanding, some people are excused. Those excused include the sick, injured, elderly, and pregnant or nursing women. They are supposed to provide food for the poor, or if able, fast at a later time instead.

Pilgrimage. The Quran commands Muslims to make a *hajj* (pilgrimage) to Mecca at least once in their lifetime if they are physically and financially able to make the journey. The hajj takes place over the first several days of the 12th month of the Islamic calendar.

The rites of the hajj commemorate the trials and sacrifices of the Prophet Abraham, his wife Hagar, and their son the Prophet Ishmael. Muslims believe that Abraham and Ishmael built the Kaaba *(KAH bah)* as the first house of worship to God. The Kaaba is an empty cube-shaped building in the center of the Great Mosque in Mecca.

The first requirement of the hajj is that men wear two pieces of unsewn white cloth, called the *ihram,* which means *garment of consecration.* Women must wear a long white gown and headscarf. While wearing these garments, a pilgrim may not kill any animal or insect, remove any hair from his or her body, or engage in any sexual act. The second requirement is that pilgrims walk around the Kaaba seven times in a counterclockwise direction.

Most pilgrims perform three additional rites, though they are not official parts of the hajj. While walking, many pilgrims attempt to kiss or touch the Black Stone, which Abraham and Ishmael placed in one corner of the Kaaba. Pilgrims may also run seven times along a corridor of the Great Mosque to commemorate Hagar's search for water for her infant son, Ishmael. Finally, pilgrims may take water from a well called Zamzam on the grounds of the Great Mosque.

The third part of the hajj involves standing at Arafat, a plain outside Mecca, on the ninth day of the pilgrimage month. During the afternoon prayer, pilgrims listen to an imam deliver a sermon from the heights of Mount Arafat at the edge of the plain. This act commemorates the final pilgrimage of Muhammad, who delivered his farewell sermon from this site.

To finish the pilgrimage, Muslims next spend the night at Muzdalifah, an encampment near a place called Mina, on the way back to Mecca. The next day, they

throw stones at the three pillars where, according to tradition, Ishmael drove away Satan's temptations. Many pilgrims also sacrifice an animal, usually a sheep or goat, at Mina. This action commemorates Abraham's vow to sacrifice his son. The hajj pilgrimage is completed after each pilgrim returns to Mecca and walks around the Kaaba seven more times.

Holidays and celebrations. All Muslims celebrate two major holidays, the Feast of Fast-Breaking and the Feast of Sacrifice. The first is held on the day following Ramadan and marks the end of the monthlong fast. The feast is a joyous occasion in which families gather for a rich meal and children receive sweets. The Feast of Sacrifice is held on the 10th day of Dhul-Hijja, the month of the hajj. On this day, many Muslims sacrifice an animal, such as a goat or sheep. A small portion of the meat is prepared for family and friends, and the rest is given to the poor.

In some countries, Muslims celebrate the birthday of Muhammad on the 12th day of the third Islamic month. Muslims spend the day praying, reading the Quran, and reciting poems and stories written in honor of the Prophet.

Muslims celebrate their New Year at the beginning of the first month of the Islamic calendar. On the 10th day of the month, members of the Shiite division hold a celebration called Ashura that marks the massacre in 680 of Husayn, a grandson of Muhammad. Muslims from Iran, Afghanistan, and central Asian countries follow an ancient solar calendar along with the Islamic lunar calendar. They often celebrate another New Year called Nawruz *(naw ROOZ)* on the first day of spring.

Islam's social structure

**The Sharī`a.** Islam has two sources of authority. The first is the word of God given in the Quran. The second is the sunna, the body of traditions that preserves the words and conduct of Muhammad. Muslim scholars use these sources to understand the principles of the *Sharī`a (shah REE ah),* also spelled *Sharī`ah,* an Arabic word that means *the way that leads to God.* It refers to the divinely revealed and inspired Islamic law that plays a central role in the lives of Muslims. Scholars recognize four main sources for interpreting the Sharī`a and applying it to daily life. They are (1) the Quran, (2) the sunna, (3) extending the reasoning of previous laws to new situations, and (4) the views of Muslim scholars and jurists.

In theory, all Islamic law is divine in origin. In practice, however, most sources of Muslim law are found in the sunna rather than the Quran, particularly in the part of the hadith that reflects Muhammad's interpretation of the Quran's rulings. The practice of deriving present-day laws from the sources of the Sharī`a is called *fiqh* (pronounced *fihk).* There are several schools of fiqh, each named after the founder of a method of interpretation. Although most Muslims agree about the major points of Islam, differences do exist, based on the opinions of the different schools of fiqh.

Ethics and morals. Actions in Islamic law are judged on five values: (1) *obligatory* (required), (2) recommended, (3) neutral, (4) disapproved, and (5) forbidden. Most religious duties, such as the Five Pillars, are obligatory. Anyone who fails to perform them may be punished by God or the Islamic state. For example, in many Muslim countries, refusal to fast during Ramadan may result in fines or imprisonment. In some Muslim countries, special organizations ensure that people make their five daily prayers at the proper time and follow accepted standards of dress and behavior.

Most actions in Islamic law are not obligatory. People who fail to perform acts that are recommended or neutral are seldom punished. Most acts that are clearly forbidden are mentioned in the Quran. They include adultery, gambling, cheating, consuming pork or alcoholic beverages, and lending money at interest. The Quran details severe punishments for such crimes as murder, theft, and adultery. Crimes are punished harshly because they violate not only the rights of the victim, but

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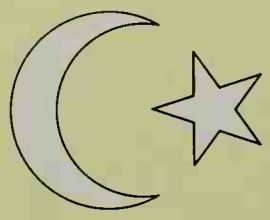
Muslims pray in a house of worship called a *mosque.* The worshipers face a decorative niche called a *mihrab* that points toward the holy city of Mecca, the direction Muslims must face while praying. Next to the mihrab is a pulpit called a *minbar.*



The symbol of Islam is a crescent and star. The symbol appears on the flags of several nations whose population has a Muslim majority, including Pakistan and Turkey.

also the commands of God. The Quran seeks to lessen the severity of these punishments, however, by urging Muslims to practice mercy and not yield to revenge.

Islamic virtues. Islam teaches respect for parents, protection for orphans and widows, and charity to the poor. It also teaches the virtues of faith in God, kindness, honesty, hard work, honor, courage, cleanliness, and generosity. Heads of families must treat household members kindly and fairly. A wife has rights against her husband and may sue for divorce in cases of physical abuse, lack of financial support, or the inability to produce a child. Islam also teaches that a person must not refuse requests for help, even if they seem unnecessary.

Divisions of Islam. There are three historic divisions in Islam. The great majority of Muslims belong to the Sunni *(SOON ee)* division. Sunni Muslims call themselves by this name because they claim to follow the Sunna of Muhammad. They follow a traditional and widely held interpretation of Islam.

Most of the conservative Muslims who Westerners call *fundamentalists* are Sunnis. Like fundamentalists of other religions, these Muslims follow a strict approach to religion. They reject modern and popular interpretations of Islamic law, which they view as too permissive. Fundamentalists insist instead on precise adherence to the Quran and Hadith, as they interpret those writings. Many Muslims dislike the name *fundamentalists*, however.

The next largest division is the Shiah *(SHEE ah)*, whose members are called Shiites. Shiite Muslims honor Ali, the cousin and son-in-law of Muhammad, and Ali's descendants, whom they believe should be the leaders of the Muslim community. Shiah comes from the Arabic phrase *shiat Ali*, meaning *supporters of Ali*.

The largest group of Shiites are the Imami *(ee MAHM ee)* Shiah. They are also known as the *Ithna Ashari*, or *Twelvers*. They see authority as residing in 12 imams, starting with Ali, who was born in about 600, and ending with Muhammad al-Mahdi, who was born in about 868. They believe this last imam is still alive, in a miraculous state of concealment from human view. He will return at the end of time to restore justice on earth. A small group of Shiites, known as the Ismaili *(ihs may EE lee)* Shiah, broke away from the Imamis in the 700's. One group of Ismailis, known as the Nizaris, still follow an imam called Aga Khan IV, who lives in France.

Today, the Kharijites make up the smallest division of Islam. Their name is based on an Arabic word that means *secessionists*. They received this name because they were former followers of Ali who broke away in 657. Kharijites are strict Muslims whose beliefs are based on precise adherence to the teachings of the Quran and Sunna as their community interprets them. They are most noteworthy for their belief in equality under God. In the first centuries of their existence, they elected their leaders and proclaimed that the best Muslim should lead his fellow believers, even if he was a slave. In some Kharijite communities in Algeria, female scholars and religious leaders serve the needs of women while male scholars and religious leaders serve the needs of men. Vincent J. Cornell

Related articles in *World Book*. See the articles on Muhammad and Muslims. Other related articles include:

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Devil	Kaaba	World, History of
Fakir	Mecca	the (The Islamic
Feasts and festivals	Medina	world; The Is-
(In Islam)	Qom	lamic empire)

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Islam, Nation of. See Nation of Islam.

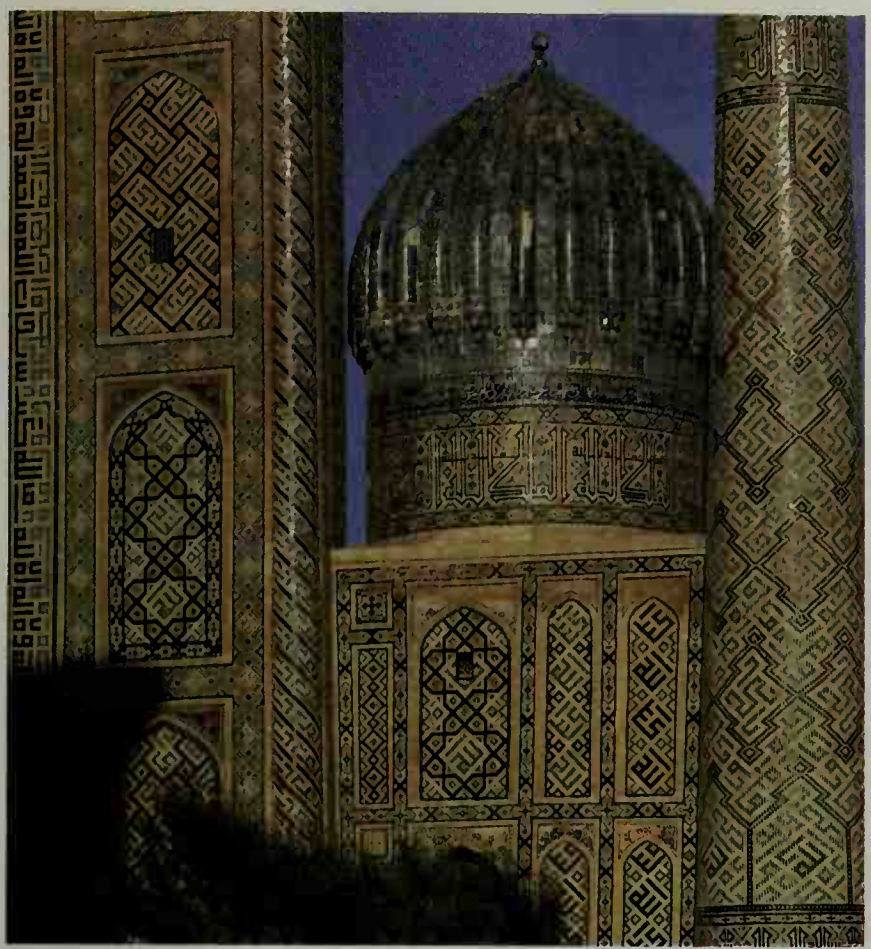
Islamabad, *ihs LAHM uh BAHD* (pop. 204,364), is the capital of Pakistan. The city lies in northern Pakistan, at the edge of the Himalaya. For location, see **Pakistan** (political map). Islamabad is a carefully planned city. It was established during the 1960's to serve as Pakistan's capital. Islamabad has wide avenues and various gardens and parks. A number of the city's buildings contain a mixture of modern design and traditional Islamic architecture.

Islamabad has four major zones—administrative, diplomatic, business, and residential. The administrative zone of Islamabad, located in the north, consists largely of government buildings. It includes the National Assembly buildings, the President's House, the Prime Minister's House, and the Supreme Court. The diplomatic zone, in the northeast corner of Islamabad, consists entirely of foreign embassies. The business zone is in the center of the city. The residential zone of Islamabad has two parts, one north and the other south of the business zone.

The residential zone is divided into sectors of 1 $\frac{1}{4}$ square miles (3.2 square kilometers) each. Each sector is a relatively independent community, with its own business district, health center, schools, and *mosque* (Muslim house of worship).

Most of Islamabad's people work for the government, which assigns housing according to each worker's rank. People who do not work for the government have to pay a high price for housing in Islamabad.

In 1959, the Pakistani government designated Islamabad to replace Karachi, a seaport, as the capital. Construction of the new city began in 1961. By the late 1960's, most of Pakistan's government offices had been moved to Islamabad. Riffat Sardar



Shir Dar madrasah (1619-1636); © R. & S. Michaud, Woodfin Camp, Inc.

Quran stand (about 1360) from central Asia; Metropolitan Museum of Art, New York City

Islamic art includes many beautiful religious colleges called *madrasahs.* Colored tiles decorate the towers called *minarets* and the dome of the madrasah at the left, built in Samarqand, Turkestan. The richly carved stand at the right was made to hold the Quran, the holy book of Islam.

Islamic art is the art of the civilization based on the Islamic religion. The Prophet Muhammad first preached the religion in Arabia during the early A.D. 600's. People who follow the teachings of Islam call themselves Muslims.

Arab Muslims began a series of conquests in the A.D. 600's and united all the countries they conquered into a single civilization. The Arabs themselves had little art. But through their conquests, they came into contact with the highly developed arts of Persia (now Iran), Syria, Egypt, and Mesopotamia (now Iraq). The peoples who accepted Islam blended these cultural influences and developed a distinct and fairly uniform style of art known as *Islamic art.* It was the product of many countries, extending from Spain to India. In Spain, Islamic art is called *Moorish,* from the Muslim group that first inhabited that country in the 700's. From the 900's on, local variations in the art appear, but the general interrelationship remains. Islamic art flourished from the mid-700's to about 1700 and then declined, especially beginning in the later 1700's.

Islamic artists were most inventive in architecture, especially in *mosques,* their houses of worship, and in palaces and such socially useful institutions as shopping areas and hospitals. They also produced beautiful textiles, metalware, pottery, carved and molded plaster, glassware, wood and ivory carvings, and book *illuminations* (decorations) and bindings. The best of these works show extraordinary mastery of technique, design, and color. They illustrate a consistent concern to beautify all aspects of daily life.

Characteristics

Islam is a strict religion. Its theologians prohibited artists from making images of living things. They feared that people might regard statues or paintings as something divine that had to be worshiped, rather than as images of God or of saintly figures. Muslims also believed that *Allah* (Arabic for God) was the one and only Creator of life. They regarded any attempt to paint or form something lifelike as trespassing on Allah's position as sole Creator. According to strict Islamic theologians, the artist who made works of art depicting living things was condemned to hellfire. Muslims usually followed the Islamic laws about images in their religious and public life. But they did not always obey these laws so strictly in their private quarters, especially between 700 and 1300 and later in India and Iran. This prohibition of pictures was more strictly followed in Turkey and the Arab world—Egypt, Iraq, Syria, and North Africa—than in India or Iran.

Design motifs. The prohibition of lifelike images channeled Islamic art into different directions. Artists usually avoided the realistic portrayal of human beings and animals. In paintings and reliefs, they designed highly stylized people, animals, and birds. These works

have an abstract, flat character that makes them more like symbols than lifelike pictures. On the whole, designers preferred floral motifs, but drew even these in an abstract style. Artists developed a special type of decoration consisting of winding stems with abstract leaves. This scrollwork, called *arabesque,* became common in Islamic art in all Muslim countries beginning in the 900's. Geometric patterning of remarkable sophistication developed in Iraq and Iran in the 1000's and then spread elsewhere as geometry acquired an almost mystical significance.

Calligraphy. Another characteristic feature of Islamic art is the wide use of Arabic script, which lends itself to *calligraphy,* the art of beautiful writing. Arabic, which is written from right to left, is the most widely used language in the Middle East. Its script was adopted for Persian, Turkish, Urdu, and most other languages used by Muslims. Excerpts from the Islamic holy book, called the *Quran,* and nonreligious writings often appear on the walls of religious buildings and on art objects. These writings, in various styles, are beautifully executed. Sometimes they are combined with floral or geometric designs, but only rarely with animal or human figures.

Common styles of Arabic calligraphy include *Kufic* and *Neskhi.* Kufic, the formal and angular style of the two, received its name from the city of Al Kufah, Iraq, where this type of writing developed. Islamic scribes used Kufic for inscriptions until the 1100's. They used it for copying the Quran from the late 600's to about 1000. Neskhi was a flowing script that was sometimes set against a background of arabesque designs. Beginning in the 1100's, Neskhi calligraphy was increasingly used for writing the Quran. Kufic was reserved for chapter headings. Other, more elaborate, writing styles developed especially in Iran and Turkey and were also used for literature.

Architecture

Mosques are the main religious buildings of Islam and are usually the most important structures in a Muslim city or town. The essential features of a typical mosque include a courtyard where worshipers gather, a *mihrab,* a *gate,* and *minarets.* The mihrab is a small central niche or arched unit that marks the wall nearest to Mecca, which the worshipers must face during prayer. The gate is a monumental, highly decorated structure set into a usually plain *facade* (front) facing the street. Minarets are slender, tall towers of various shapes. The faithful are called to prayer five times a day from a balcony at the top of a minaret. Inside every mosque is a pulpit called a *minbar.* The minbar may be made of wood or stone.

Styles of mosques vary from one country to the next. A large dome became the chief feature of the mosques of Persia, India, and Turkey. A high, arched entrance with a minaret on each side also characterized mosques in Persia and India. For a fine example of these features, see **Iran** (picture: A beautiful blue-domed *mosque*). The typical Turkish mosque has an enormous enclosed central space covered by a dome and half domes resembling Byzantine churches. The Mosque of Sultan Selim in Edirne, Turkey, is a good example of this type. Many Persian, Spanish, and North African mosques are covered with tilework.

The Ardabil rug (1540) by Maksud al-Kashani; Victoria and Albert Museum, London

A Persian rug has characteristic dark colors and elaborate abstract and floral patterns. The rug shown above, which is 36 $\frac{1}{2}$ feet (11 $\frac{1}{2}$ meters) long, was made for a royal family.

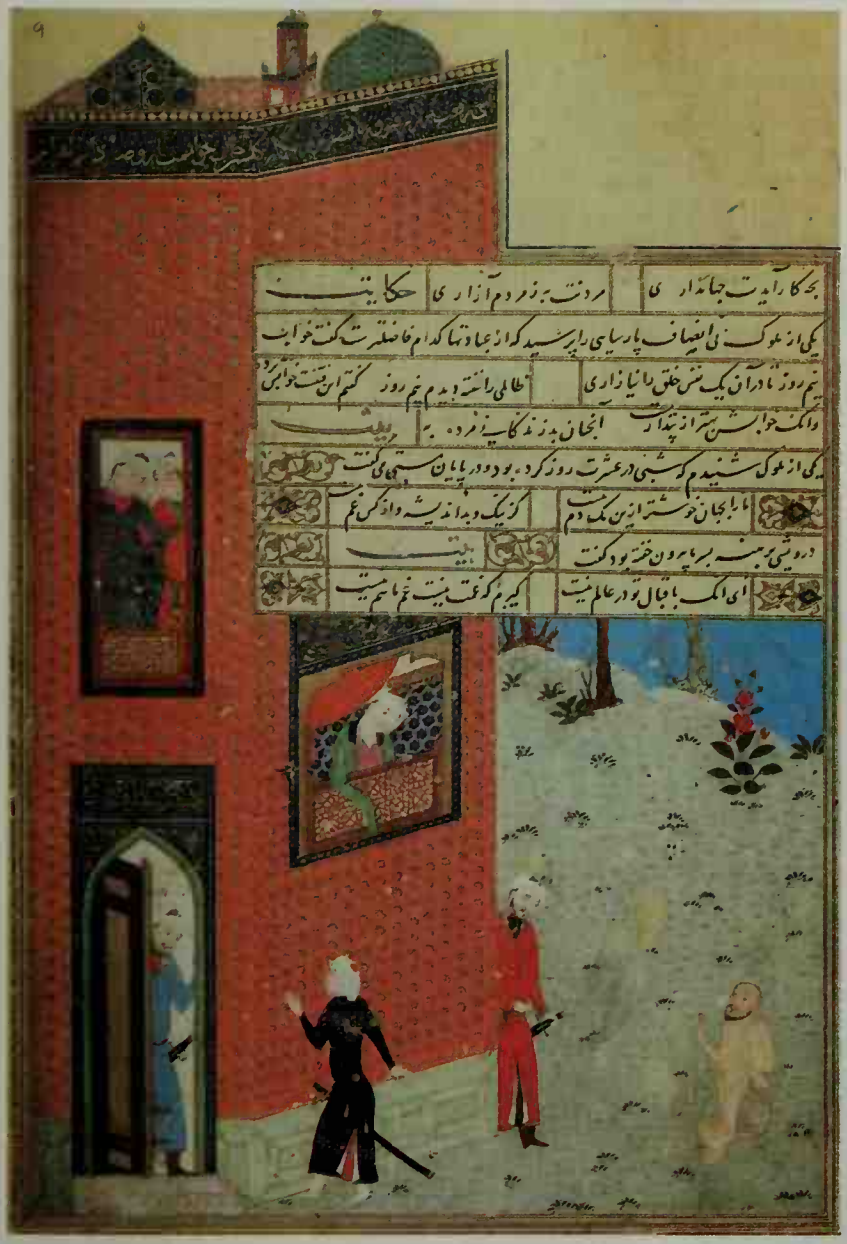
Madrasahs, or religious colleges, also provide important examples of Islamic architecture. The madrasah is usually a four-sided building standing around an open courtyard. The center of each side of the quadrangle consists of an arched large hall, called an *iwan* or *eyvan,* which is open to the courtyard and used for lectures. Students attend classes in the iwans and live in individual cells that are located along the four sides of the courtyard between the iwans.

Other buildings. Tombs provide some of the most striking examples of Islamic architecture. Builders cover a tomb with a square or eight-sided building. A dome is built over the building. They also build a round or many-sided tower with a roof that is cone- or pyramid-shaped. The most famous Islamic tomb is the Taj Mahal in Agra, India.

The rulers of various Islamic countries built many pal-

Ivory box (about 1005); Cathedral Museum, Pamplona, Spain (Ampliaciones y Reproducciones MAS)

Islamic carving in Spain included intricate animal and floral decorations, such as those on the carved ivory box shown above.



Painting (1427) by an unknown Persian artist; Chester Beatty Library, Dublin, Ireland (Pieterse-Davison International Ltd.)

Islamic painting is best known for beautiful illustrations in books that also feature elegant handwriting called *calligraphy.* The above painting is from the *Gulistan,* a collection of poems and stories by the Persian writer Saadi.

Luster-painted vase (late 1200's) by an unknown Syrian artist; private collection, Paris (Josse)

Islamic pottery featured a form of decoration called *luster painting,* in which artists used metallic paint on a blue or white glaze.

aces, but only a few of these structures remain. Of the later ones, the best known is the Alhambra at Granada, Spain, built from 1248 to 1354. Others include the palaces of the Mogul emperors of India in Agra, Delhi, and Lahore, all built in the 1600's. Other examples of Islamic architecture include inns called *khans;* large fortified resthouses along trade routes; hospitals; and market streets or bazaars called *sooks.*

Islamic architecture has many unique features. Perhaps the most original is the *muqarnas vault,* a stalactite-like honeycomb ceiling in which up to 5,000 small carvings are set at angles to each other.

Decorative arts

Rugs. Traditionally, people sat or slept on rugs on the floor. Islamic craftworkers developed carpet weaving into a fine art. Craftworkers used small lengths of various colored threads of wool or silk to make knots into specific patterns. The knots created a *pile* with a richly decorated surface. Some of the finest silk rugs have 1,000 knots per square inch (160 per square centimeter). Sometimes craftworkers brocaded the rugs with gold and silver. The main areas of rug production in the Muslim world were central Asia, Turkey, Iran, and the Caucasus region of Russia.

Few rugs remain that date from before 1500. Persia produced the most elaborate rugs. The weavers of Persia and India preferred floral designs, scrolls, arabesques, and medallions, occasionally combined with animal or human figures. Many of these rugs seem to create the atmosphere of a garden. A few of them actually follow the general layout of a formal Persian garden, with trees, flower beds, and bodies of water stocked with ducks and fish. Most rugs that are made by Turkish weavers display abstract or geometric designs. In many cases, the precise origins of the rugs are unknown or the subject of disagreement among experts. Scholars of Islamic art generally classify the rugs according to their

design, their period, and their country of origin.

Textiles. The art of weaving on a loom reached a high development in Islamic countries. Fine textiles date from the 700's on. They were used for clothing, for such decorative elements as wallhangings and coverings, for gifts, and even for tents. Many were woven with silk thread. Early fabrics had designs based on those used in silks of pre-Islamic Persia. After the 1250's, craftworkers used Chinese motifs. In the 1500's and 1600's, Persian weavers created scenes with figures inspired by contemporary miniature paintings. Other textiles used floral designs and geometric patterns.

Metalware. Few objects of gold or silver by Islamic artisans have been preserved. Islamic religious authorities have frowned on the use of precious metals. As a result, metalworkers achieved beautiful effects by *chasing* (tracing) bronze or brass objects. They sometimes inlaid one of these metals with copper, silver, or gold to form inscriptions or designs. At times, metalworkers inlaid them with a black sulfuric alloy called *niello.* Artisans who worked with base metals usually chased or embossed them.

Candlesticks, basins, boxes, mortars, trays, and water pitchers typify Islamic metalwork. The best works appeared between about 900 and 1400. Mosul, in Iraq, became one of the principal centers of inlaid bronze work. Cairo, Damascus, and eastern Persia were also important production centers.

Pottery reached its highest development between the 800's and the 1600's. Muslim artists developed many techniques that are still used today. For example, they engraved into *slip,* an earthy coating under the glaze, or else painted on the slip, and then added transparent glazes of many colors. These techniques were imitated by Byzantine and Italian ceramists. Islamic potters also painted with a metallic pigment on a white or blue glaze to produce so-called *luster painting.* This difficult technique, practiced in the Middle East and Spain from the 800's through the 1600's, was also taken over by the potters of the Renaissance period in Italy.

Builders used bright tiles decorated with geometric or arabesque designs for wall surfaces and fountains. Outstanding examples of tilework decorate mosque walls, domes, and minarets in Isfahan, the capital of Iran in the 1600's. Tilework was an ancient Persian art.

Carved and molded plaster decorate buildings from Spain to Turkestan. Craftworkers designed floral arabesques and large letters in wet plaster on walls and arches. The Alhambra in Spain contains examples of wall surfaces that are richly covered with stalactites and intricate geometric ornaments and inscriptions, all molded in stucco and painted or gilded.

Glassware was used for mosque lamps, drinking utensils, vases, and windows. Artisans practiced most of the processes of glassmaking known since ancient times. The finest Islamic glassware has relief designs of animals and arabesques. Glassmaking flourished in Iraq, Persia, and Egypt from the 700's to the 1100's. Syrian glassmakers became famous in the 1200's and 1300's for glass bottles, drinking vessels, and mosque lamps decorated with colored enamels. Builders used richly colored glass windows in many buildings, especially in mosques but also in private mansions. They filled wooden or stucco frames with bits of colored glass attached with wet plaster. The designs often consisted of abstract trees and flowers and geometric patterns.

Carvings. Craftworkers carved wood into intricate patterns. They used wood for doors, boxes, ceilings, panels, prayer niches, and pulpits. Woodworkers often carved elaborate inserts into a plain geometrical framework of star designs. Sometimes they made these of ivory. They also carved ivory for valuable objects, especially for round boxes, chests, and hunting horns in Spain, Egypt, and southern Italy. Egyptian craftworkers often covered the domes and arched doors of mosques with arabesque carvings in stone. Indian art features carved marble window screens. Builders made these by cutting geometric or realistic motifs out of a slab of marble until it was perforated by tracery.

Books. Although there are examples of early wall paintings, better-known Islamic painting originated as book illustrations. Most of the earliest remaining examples date from after 1200. The Persians had rich literary traditions, and illustrated many poems, such as the epic *Shah-Namah (Book of Kings),* by the poet Firdausi. They also chose the *Quintet (Khamsah)* by the poet Nizami and the poems and prose works by Saadi, including the *Bostan (Fruit Garden)* and the *Gulistan (Rose Garden).* Another popular subject was a book of fables, *Kalila and Dimna,* which came from an Indian collection, the *Panchatantra.* Artists also painted miniatures in books on plants, animals, and constellations.

Persia developed several styles of painting as the country was conquered by other Islamic peoples, including the Turks and the Mongols. The greatest period in Persian art extended from the 1300's to the late 1600's. The best-known Persian painter, Kamal ad-Din Bihzad, illustrated famous manuscripts with miniatures in the late 1400's. During the late 1500's, artists in India began to produce a more realistic style of painting. These artists especially excelled in painting portraits that were kept in albums. Beginning in the late 1500's, painters in Ottoman Turkey concentrated on illustrating historical works in a realistic manner. Manuscripts of the Quran never had decorations showing human figures or animals. Islamic painters decorated the sacred book with graceful scrolls and floral ornaments around the beautifully written texts.

Islamic books are enclosed in delicately worked leather bindings, which nearly always have a flap on the lower cover to be folded over all the pages. Persian craftworkers made bookbindings with molded or tooled designs on the outside and cut-out patterns on the inside. Some of these date back to the 1400's. Beginning in the mid-1200's, many bookbindings had part of their designs imprinted in gold. Experts consider Islamic bookbindings to be among the most beautiful bindings ever produced. Oleg Grabar

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Painting (Asian painting)
Rugs and carpets (Oriental rugs)
Spain (The arts)

Islamic calendar. See Calendar (The Islamic calendar).

Island is a body of land smaller than a continent and surrounded by water. Islands lie in oceans, rivers, and lakes throughout the world. They vary greatly in size. Greenland is the largest island in the world. It covers 836,330 square miles (2,166,086 square kilometers). Some islands cover a smaller area than a city block. A small island is called an *islet*. The distinction between a continent and an island is based on size. Australia is more than three times as large as Greenland. Because of its size, geographers class it as a continent.

Islands make up the entire land area of some countries, including Japan and the Philippines. Millions of people live on such islands. Other islands have no people. Some of these islands, such as Pelican Island in Florida and the Oregon Islands in Oregon, are wildlife refuges.

Throughout history, islands have served as stopping points on migration and trade routes and as stations for refueling and supplying ships. Islands have thus aided the spread of people, animals, and plants from one continent to another.

Some islands were formed hundreds of millions of years ago. But new ones are forming continually. For example, Iceland was formed millions of years ago by an oceanic volcano. In 1963, Surtsey, a new volcanic island, appeared near the coast of Iceland.

A broad expanse of sea with a large number of islands is called an *archipelago*. In most cases, all the islands of an archipelago are formed by the same process. For example, the Galapagos Islands were formed by volcanoes that built up from the ocean floor.

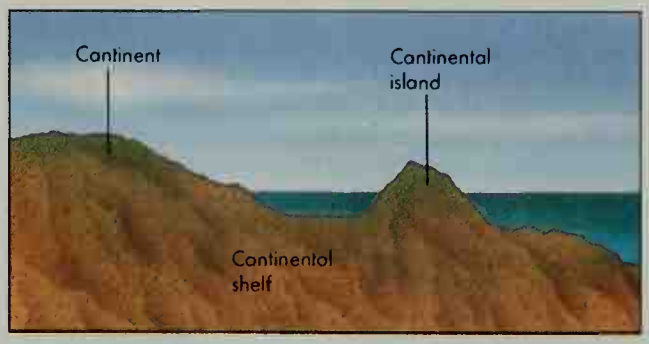
Kinds of islands. There are five main kinds of islands: (1) continental islands, (2) tectonically formed islands, (3) volcanic islands, (4) coral islands, and (5) barrier islands. Each kind is formed in a different way. Some islands are formed by a combination of processes.

Continental islands are areas of land that were once connected to a continent. Some of these islands were isolated from the mainland as a result of a rise in sea level. For example, the British Isles were connected to the mainland of Europe more than 10,000 years ago, when glaciers covered parts of the Northern Hemisphere. As the glaciers began to melt, they made the sea level rise. As a result, water covered the land that had connected the British Isles to the mainland.

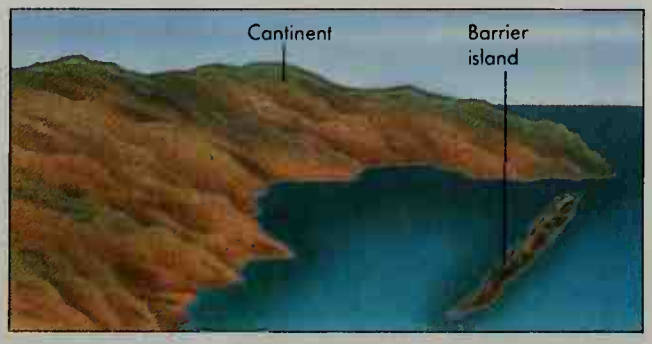
Other continental islands resulted from the erosion of a former link with the mainland. Streams, rivers, and

The world's 10 largest islands

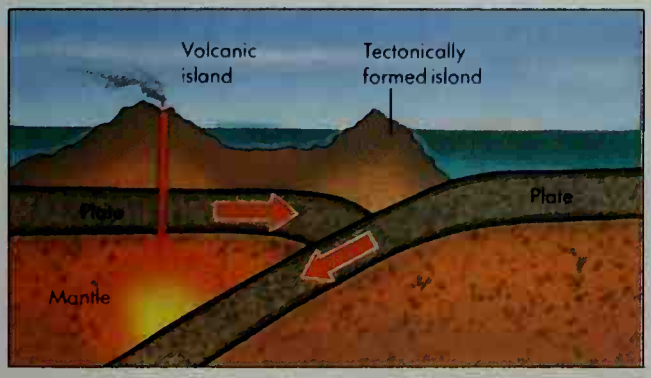
Island	Area in sq. mi.	Area in km²
Greenland	836,330	2,166,086
New Guinea	342,000	885,780
Borneo	287,000	743,330
Madagascar	226,658	587,042
Baffin	183,810	476,068
Sumatra	182,860	473,606
Honshu	89,000	230,510
Great Britain	88,764	229,898
Victoria	81,930	212,200
Ellesmere	75,767	196,236

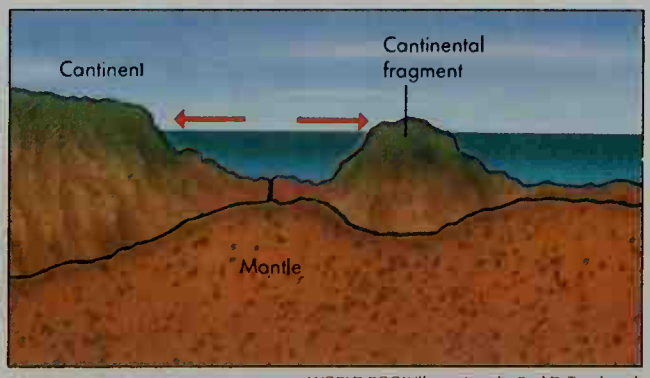


Continental islands are fragments of land that were once connected to a continent. Some were isolated from the mainland after the sea level rose. Such islands lie on submerged land called *continental shelves*, which border the continents.



Barrier islands consist of sand and soil that build up along a shoreline. Winds and ocean waves pile up the sand into long, narrow islands. Many barrier islands lie along the Atlantic coast of the United States and along the Gulf of Mexico coast.





WORLD BOOK illustrations by Paul D. Turnbaugh

Tectonically formed islands are created by movements of the plates that make up the earth's rocky outer shell. When one plate slides under another, pieces scraped off the bottom plate may pile up to form an island. An island also may form when pieces of a land mass drift apart.

ocean waves may, over thousands of years, wear away land that had connected an island to a continent.

Tectonically formed islands are created by movements in the earth's crust. The outermost layer of the earth consists of huge, rigid plates that are in very slow, but constant, motion. When one plate is pushed under another plate, the top plate may scrape off pieces of the bottom plate. Over millions of years, this material piles up to form an island. Barbados in the West Indies and Kodiak Island near Alaska were formed this way.

Movements of the earth's tectonic plates also cause land masses to drift apart. Scientists believe that the present continents are parts of what was once a single large continent. This land mass broke up about 200 million years ago, and ocean basins formed between the fragments. The smaller land fragments thus became tectonically formed islands. Greenland and Madagascar were formed this way. Slow movements of the earth's crust are still occurring, and so new islands will continue to be formed. In several million years, southwestern California will probably have moved to the northwest to form an island off the west coast of North America. See **Plate tectonics.**

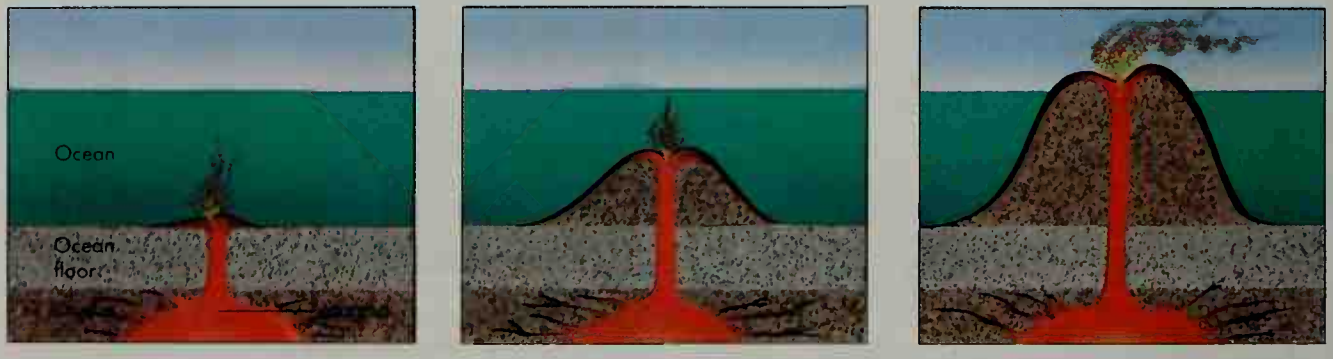
Volcanic islands consist of lava and ash built up from the ocean floor by eruptions of oceanic volcanoes. These islands include the Hawaiian Islands. Some volcanic islands, such as the Aleutian Islands and those of Japan, form *island arcs.* Island arcs are narrow, curving chains of volcanic islands that form along the border of deep trenches in the ocean floor. The Lesser Antilles, an island arc in the West Indies, were built up by volcanic activity about 50 million years ago.

Coral islands are low, flat islands that consist chiefly of *coral reef* material. Coral reefs are limestone formations composed of tiny sea organisms and their remains. They form and grow in warm, shallow water.

Many coral islands develop from reefs that grow up around volcanic islands. Some volcanic islands sink because of the movement of oceanic plates. Others become submerged following a rise in the sea level. As islands sink or as the sea level rises, the reefs grow upward until only *atolls* remain. An atoll is a circular reef that surrounds a central body of water called a *lagoon.* Ocean waves break away parts of the reefs and pile up this material into flat, sandy islands. The Pacific Ocean has many atolls, including Bikini Atoll and Enewetak. See **Atoll; Coral.**

Barrier islands consist of *sediment* (sand, silt, and gravel) that builds up along a shoreline. Streams and rivers wear away their banks and carry sediment to the shallow waters of seashores. Ocean waves and winds pile up the sand into a series of ridges and dunes parallel to the shoreline, forming barrier islands. Many barrier islands lie along the gently sloping Atlantic coast of the United States and the shores of the Gulf of Mexico. They include Hatteras Island in North Carolina and Padre Island in Texas.

Some barrier islands that lie along coastlines are formed by glacial deposits. The glaciers that once covered much of the Northern Hemisphere piled up large ridges of rocks, sand, silt, and clay in front of them in what are now coastal areas. Parts of these ridges, called *moraines,* have been eroded or submerged, but other parts remain, forming barrier islands. Long Island in



Volcanic Islands are formed by oceanic volcanoes. *Magma* (molten rock), which comes from a layer of the earth called the *mantle,* may erupt through the earth's crust, *left.* The eruptions deposit large amounts of lava on the ocean floor, *center.* The lava builds up above sea level and forms an island, *right.* The islands of Hawaii and those of Japan were formed by oceanic volcanoes.

WORLD BOOK illustrations by Paul D. Turnbaugh

Coral Islands are formed by *coral reefs,* limestone formations composed of tiny organisms and their remains. A coral reef may grow around a sinking volcanic island, *left.* As the island sinks or the sea level rises, the reef grows upward and forms a ringlike *barrier reef, center.* After the island has submerged, only a circular reef called an *atoll* remains, *right.*

New York and Nantucket in Massachusetts were formed this way.

How life develops on islands. Continental islands originally had a plant and animal community like that of the continent from which they separated. Volcanic, coral, and barrier islands originally have no land animals or plants. These lands become inhabited by birds that fly across the sea and by other animals that swim to the islands. Some animals and insects may be carried to islands on logs or other debris. Plant seeds may float across the sea or be carried by birds or the wind.

The animals and plants that live on an island are cut off from those elsewhere. Because of their isolation, these animals and plants may *evolve* (gradually develop) into species not found on the mainlands. For example, the giant tortoises of the Galapagos Islands evolved from ancestors that were much smaller. Some sunflower plants that grow on the Galapagos Islands have developed into tall trees.

Many island animals evolve into numerous species, each of which lives in a very particular habitat. For example, the *finch,* a songbird, has developed into more than 10 species on the Galapagos Islands. Some of these species live chiefly in the trees and feed on insects. Other types of finches live mainly on the ground and eat seeds and fruits.

Many kinds of island animals would probably not survive elsewhere. But on islands, there are fewer animals to prey on them and to compete with them for food.

Grenville Draper

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Juan Fernández
Marajó
Tierra del Fuego

West Indies

Anguilla
Antigua and Barbuda
Aruba
Bahamas
Barbados
British West Indies
Cayman Islands
Cuba
Curaçao
Dominica
French West Indies
Grenada
Grenadines
Guadeloupe
Hispaniola
Jamaica
Leeward Islands
Martinique
Montserrat
Netherlands Antilles
Puerto Rico
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Trinidad and Tobago
Turks and Caicos Islands
Virgin Islands
Virgin Islands, British
West Indies
Windward Islands

Islands of the Blessed. See Elysium.

Isle of Man. See Man, Isle of.

Isle of Orleans. See Louisiana (Spanish rule).

Isle of Wight. See Wight, Isle of.

Isle Royale National Park includes the large island for which the park was named and more than 200 small nearby islands. They lie in the northwest part of Lake Superior (see Michigan [physical map]). They have 196 miles (315 kilometers) of shoreline. The islands are part of Michigan, although they are nearer to Minnesota and Canada. For the area of the islands, see National Park System (table: National parks).

Isle Royale, the largest of the islands, is 45 miles (72 kilometers) long and from 3 to 9 miles (5 to 14 kilometers) wide. This island has more than 30 inland lakes. Lake Siskiwit, the largest of the lakes, has several small islands of its own. Isle Royale is one of the few places in the world where copper is found in almost pure form. But mining is no longer carried on there.

One of the largest moose herds in the United States grazes on the island. The park is a refuge for other wild animals, including beavers, squirrels, rabbits, and timber wolves. Streams abound with freshwater fish. Many kinds of birds and flowers are found there. At least 30 kinds of orchids bloom in summer. Native trees include oak, maple, birch, and evergreens. The islands became a national park in 1931.

Critically reviewed by the National Park Service

See also Ecology.

Ismail Pasha. See Egypt (History).

Ismaili Khoja Muslims. See Islam (Divisions of Islam).

Isobar, *EYE suh bahr,* is a line drawn on weather charts and maps to connect places that have the same atmospheric pressure. It is also called an *isobaric line.* The word *isobar* comes from the two Greek words *iso,* which means *equal,* and *baros,* which means *weight.*

Charts showing the areas of high, normal, and low pressure are useful in forecasting the weather. Winds tend to blow almost parallel to the isobars. The movement of storms can be predicted using isobaric charts. Pressure may be marked on the chart in inches and tenths of an inch, or it may be measured in a smaller unit called the *millibar.* An isobaric map may show the average pressure for a year, or it may show the pressure at a given moment. Daily charts show the atmospheric conditions. Margaret A. LeMone

See also Barometer; Weather.

Isocrates, *eye SAHK ruh TEEZ* (436-338 B.C.), was an important Greek author and educator. A weak voice and stage fright kept him from making public appearances as a speaker. But he wrote many great orations and published them in pamphlet form. He repeatedly urged a Greek invasion of Persia to unify and enrich his country. Twenty-one of his orations still exist. They are noted for polished style and careful form. He often worked for years on one speech.

Isocrates was born in Athens. He studied under several philosophers and was a follower of Socrates. Isocrates found his calling about 392 B.C. when he set up his famous school of oratory and rhetoric in Athens. The schools of Plato and the Sophists were his rivals. His pupils included some of the greatest orators, historians, debaters, and writers of Greece of his day.

Cynthia W. Shelmerdine

Isolationism, *EYE suh LAY shuh nihz uhm,* is the doctrine of people who believe a nation should hold itself separate from other nations. Strict isolationists believe it is a mistake for their countries to become involved in international trade agreements or mutual-assistance pacts. Less radical isolationists argue that nations should limit international involvement so as not to draw themselves into dangerous conflicts. Michael P. Sullivan

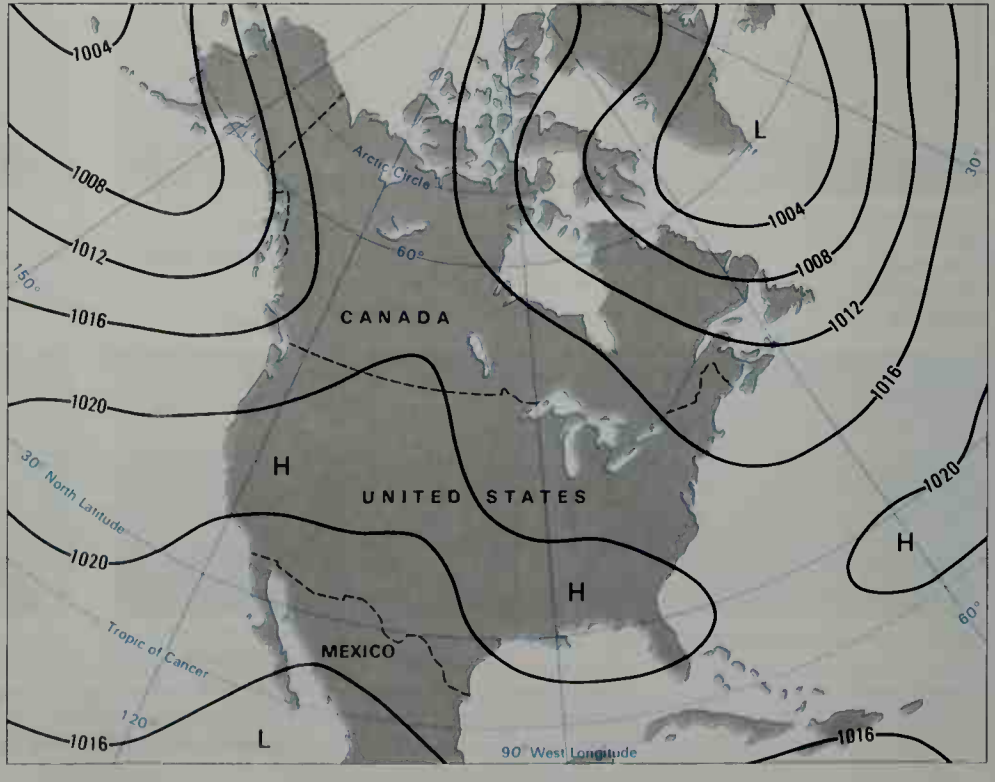
See also United States, History of the (Looking backward); America First Committee.

Isobar

Isobars on a map connect places that have the same air pressure. This map shows the average January isobars for most of North America. Air pressure is measured in inches or millibars. The pressures on this map range from 1004 to 1020 millibars.

H Center of high-pressure area

L Center of low-pressure area



WORLD BOOK map

Isomers, *EYE suh muhrz,* are two or more chemical compounds that have the same number of each kind of atom, but differ in the way the atoms are arranged. Because the atom arrangement varies, isomers generally differ from each other in both their physical properties and their chemical behavior.

For example, *normal butane* and *isobutane*—the two types of the gas *butane*—are isomers. The two have the same formula, C_4H_{10}. But, because the arrangement of atoms in their molecules differs, normal butane and isobutane have different boiling points. Normal butane boils at −0.5 °C, but isobutane boils at −12 °C.

Robert C. Gadwood

Isometrics, *EYE suh MEHT rihks,* is a method of exercise that involves little or no visible movement. To perform isometrics, people push or pull against an immovable object, such as a wall, a heavy desk, or another part of their body. This pushing or pulling activity *contracts* (tightens and shortens) the muscles. If the muscle contraction moves the object, the exercise is called *isotonic,* or *dynamic.*

Isometrics, if practiced for a few minutes daily, will rapidly strengthen the muscles as well as maintain muscle tone. Most isometric exercises require no special equipment. Herb Weber

Isomorphism, *EYE suh MAWR fihz uhm,* in chemistry, is a close similarity in the crystal structure of certain substances that have different chemical formulas. Isomorphism generally occurs with compounds that have similar formulas and that are composed of ions of similar charge and size. Isomorphism probably occurs because similarly charged and sized ions tend to pack together in similar arrangements. Peter A. Rock

Isoniazid, *EYE soh NY uh zihd,* is one of the most effective drugs used in the treatment of tuberculosis. Its chemical name is *isonicotinic acid hydrazide* (INH). Its chemical formula is $C_6H_7N_3O$. Isoniazid is *synthesized* (made artificially) from other compounds. American chemists developed the drug in the early 1950's.

Christopher A. Rodowskas, Jr.

See also **Tuberculosis** (Treatment of tuberculosis).

Isooctane. See **Gasoline; Octane.**

Isoprene. See **Rubber** (The chemistry of rubber).

Isoptera, *eye SAHP tuhr uh,* is an order of insects that live in colonies similar to those of ants and bees. Insects of this order are commonly called *termites,* or white ants. About 2,000 species of termites are known. They live chiefly in warm regions.

See also **Termite; Insect** (table).

Isosceles triangle. See **Triangle.**

Isotherm, *EYE suh thurm,* is a line drawn on maps to connect places that have the same temperature. It is also called an *isothermal line.* A weather observer makes a monthly isothermal map by first averaging all the temperatures at any one place during the month to find the *mean* (average) temperature. Then the observer draws isotherms connecting places that have the same average.

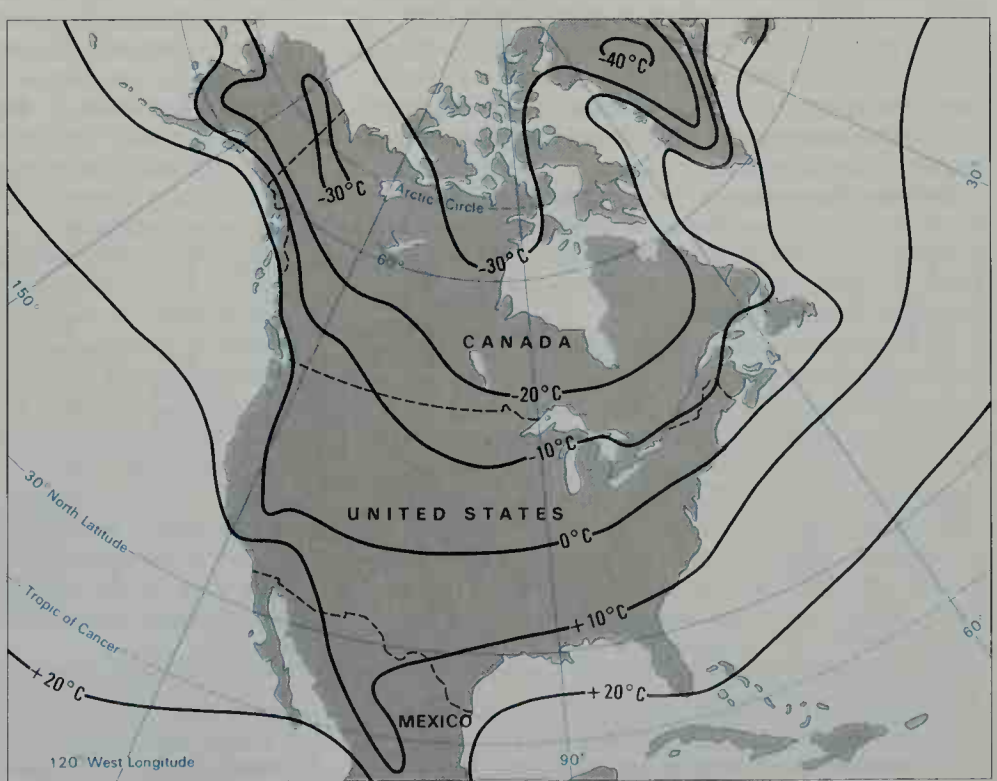
Places that have the same latitude on the map often vary in temperature, and so isothermal lines are irregular. They curve back and forth, up and down, over the map. The greatest irregularity in isothermal lines occurs in the Northern Hemisphere, where great land masses are separated by large water areas, with varying temperatures on land and water in the same latitude. In the Southern Hemisphere, the oceans are larger and there is less land. There, the isotherms follow the parallels of latitude more closely, the cooler ones lying toward the south.

A line drawn near the earth's equator, through the middle of the belt with the hottest climate, is the *heat equator.* This isotherm connects places with average temperatures of about 80 °F (27 °C). Donald T. Acheson

See also **Climate; Weather.**

Isotherm

Isothermal lines on a map connect places that have the same average temperature. The map at the right shows the January isotherms for most of North America. Temperature is measured in degrees. Average temperatures shown on the map range from −40 °C to +20 °C.



WORLD BOOK map

Isotope, *EYE suh tohp,* is one of two or more atoms of the same element that differ in atomic weight. Some elements, such as aluminum, fluorine, gold, and phosphorus, have only one naturally occurring isotope. All atoms of these elements have the same weight.

Most elements have several naturally occurring isotopes. For example, hydrogen has three isotopes. Its lightest and most abundant isotope, called *protium,* has a *mass number* of 1—that is, the nucleus of the atom contains only one particle. This particle is a proton, and so it has a positive charge. The second isotope, called *deuterium* or *heavy hydrogen,* has a mass number of 2. The nucleus of a deuterium atom contains two particles—one proton and one neutron, which is electrically neutral. The neutron has almost the same mass as the proton. The heaviest hydrogen isotope, *tritium,* has a mass number of 3 and is radioactive. The nucleus of this atom contains three particles—one proton and two neutrons. See **Atom** (The mass number; Atomic weight).

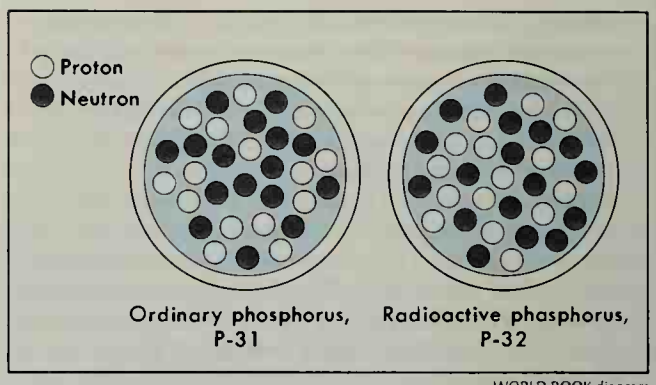
The number of protons in the nucleus of the atoms of an element determines the *atomic number.* Thus, the atomic number of hydrogen is 1. No two elements have the same atomic number. Each successively heavier element has one more proton in its nucleus. Uranium, the heaviest element found in sizeable amounts in nature, has 92 protons. Its atomic number is 92. All the isotopes of an element have the same number of protons, but a different number of neutrons. The number of protons plus the number of neutrons equals the mass number of the isotope.

Scientists use symbols to identify isotopes. For uranium (chemical symbol, U), the isotope of mass number 235 may be written $^{235}_{92}U$. Since all atoms of an element have the same atomic number, it may be omitted: ^{235}U, which may also be written U-235.

Some elements have many naturally occurring isotopes. Tin, for example, has 10. The lightest tin isotope is ^{112}Sn and the heaviest is ^{124}Sn. The most abundant tin isotope is ^{120}Sn, which makes up about a third of the element. The least abundant is ^{115}Sn. Only 0.34 percent of the tin atoms are this isotope. Except for a few special cases, the relative proportions of the different isotopes in a sample of an element are always the same, no matter where the sample comes from.

Radioactive isotopes. More than 270 stable isotopes occur in nature. About 50 other natural isotopes, including those of uranium and radium, are radioactive. These isotopes, which give off particles or radiations, are called *radioisotopes.*

All the elements heavier than bismuth (atomic number 83) are radioactive. These radioactive atoms *decay* (break down) into lighter-weight isotopes of other elements. They belong to three radioactive *decay series,* which start with ^{238}U, ^{235}U, and ^{232}Th. These heavy atoms decay into various isotopes until they eventually become stable isotopes of lead. The rate at which radioactive isotopes decay is measured by the *half-life,* or the time required for half the atoms in a sample to decay. Every isotope has a specific half-life. Some isotopes in the radioactive series decay slowly. For example, the radium isotope ^{226}Ra has a half-life of 1,600 years. Others decay much faster. Some have half-lives of a small fraction of a second. Isotopes that have short half-lives can occur naturally because they are continually being formed by the decay of the *parent* (heaviest) isotope of the series.



WORLD BOOK diagram

The isotopes of an element contain a different number of neutrons. For example, ordinary phosphorus, P-31, has 16 neutrons, *left,* but its radioactive form, P-32, contains 17, *right.*

A few scattered radioactive isotopes that do not belong to the series exist among elements lighter than bismuth. These elements include potassium-40, rubidium-87, samarium-146, lutetium-176, and rhenium-187.

Separating isotopes. In the early 1940's, during World War II, scientists developed processes for separating large quantities of various isotopes. The separation of uranium isotopes and hydrogen isotopes has proved especially useful. For example, ^{235}U is separated from the more abundant ^{238}U for use in atomic bombs and various nuclear reactors. Similarly, deuterium, ^{2}H, has to be separated from the abundant light hydrogen isotope, ^{1}H, for use in hydrogen fusion research and for other purposes (see **Fusion**).

The methods of separating deuterium from light hydrogen depend on the fact that deuterium is twice as heavy as light hydrogen. The rate of a chemical reaction depends on the mass of the element involved. The relative difference between the masses of the two hydrogen isotopes is large. Therefore, a reaction involving deuterium proceeds at a different rate from that of a reaction involving light hydrogen. By making use of this principle, scientists separate deuterium from light hydrogen on a large scale. They produce large quantities of deuterium each year. The relative difference in mass between boron-10 and boron-11 is also large enough for this method of separation.

The relative difference in mass between the various uranium isotopes is so small that scientists must use other methods to separate them. The most successful method is called *gaseous diffusion.* This method depends on the fact that in a gas, a heavier molecule moves somewhat more slowly than a lighter one. As a result, in a gaseous compound that contains uranium, a molecule containing the lighter isotope passes more easily through tiny holes in a porous sheet. If this process is repeated several thousand times in a row, a useful amount of the lighter isotope becomes separated. Huge laboratories in the United States and other countries separate large quantities of uranium isotopes by this method.

Pure isotopes of most elements are available in small amounts for experimental purposes. These isotopes are produced by still another method, which can be adapted for use with many elements. An electrical dis-

charge *ionizes* a vapor of the element or of a compound containing the element. In ionization, one of the electrons that orbit around the atom's nucleus is knocked off. The atom then has a positive charge.

An electric field accelerates the charged atoms, called *ions,* to a definite energy. This process produces a beam of ions, in which all the ions have the same energy. When a magnetic field bends the ion beam, the ions with different masses separate into circles of different radii. Each circle consists of a different isotope of the element. The process takes place in a container from which the air has been removed. Scientists used this method during World War II to separate uranium isotopes. But the gaseous diffusion method proved less expensive. A somewhat similar process, called *mass spectroscopy,* is used to measure the relative abundance of naturally occurring isotopes and to make precise determinations of nuclear masses (see Mass spectroscopy). A number of other methods have also been used to separate isotopes.

Artificial radioisotopes. Scientists have artificially produced many radioisotopes that do not occur in nature. If they ever did exist naturally, they long ago decayed away. These artificial isotopes can be produced either in cyclotrons and other particle accelerating devices or in nuclear reactors. For example, scientists may bombard an isotope of sodium, ^{23}Na, with high-energy *deuterons* in a cyclotron. A deuteron is a particle made up of a proton and a neutron. When a deuteron collides with a ^{23}Na atom, a nuclear reaction occurs. The neutron becomes part of the nucleus of the atom and a proton is ejected, producing ^{24}Na. See Particle accelerator. Radioisotopes are also made by exposing elements to the large number of neutrons in a nuclear reactor. For example, in a reactor, ^{23}Na atoms capture neutrons and become ^{24}Na. The *fission* (splitting) of uranium leads to the formation of more than 450 radioactive isotopes and over 100 stable isotopes.

Scientists have produced about 1,700 radioisotopes. Artificial isotopes of all the elements have been produced. For many elements, 15 or more artificial isotopes are known.

All elements not found in the earth have been artificially produced. These include technetium and promethium, which are present in some stars, and the transuranium elements, elements 93 through 112 (see Transuranium element). These radioactive elements have such short half-lives that they have vanished from the earth by decaying into other elements. An exception is plutonium. Scientists have found very small amounts of the plutonium isotope ^{244}Pu in the earth.

Uses of radioisotopes. Radioisotopes have many important uses in science and industry. Because they are radioactive, they can be easily detected, even in very small amounts. They are identical chemically with other isotopes of the same element, so they can take the place of the common isotopes in chemical reactions. Thus, they can be used to study the details of chemical or biological reactions. For example, biochemists use radioactive carbon to trace the path of carbon atoms in the photosynthesis process in green plants. They detect the particles and rays emitted by the radioactive atoms with such devices as Geiger counters, gamma-ray spectrometers, and proportional counters.

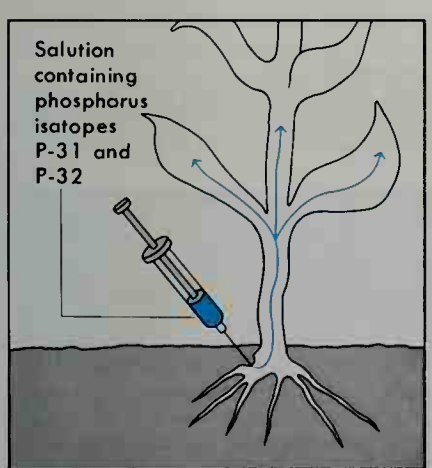
Radioisotopes are widely used in *nuclear medicine,* which employs radioactive materials to study, diagnose, and treat certain diseases. Radioisotopes also are used in various kinds of environmental studies, particularly those concerned with nuclear radiation.

In industry, radioisotopes are often used to measure the thickness of materials. The radiation emitted by radioisotopes is partially absorbed in passing through materials. Radiation detectors are used to measure the intensity of the radiation that has passed through the materials. Variations in the intensity of the radiation indicate differences in the thickness of a material being inspected. Darleane Christian Hoffman

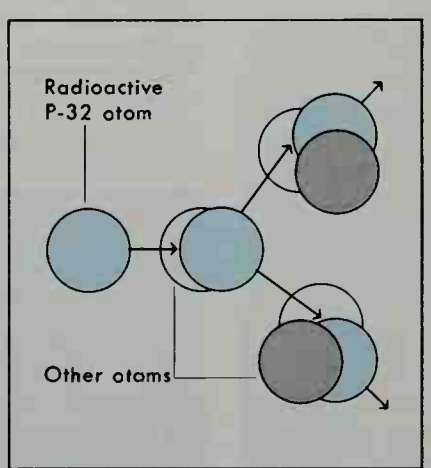
See also Element, Chemical; Oak Ridge National Laboratory; Radiation; Radiochemistry; Uranium (Separating uranium isotopes).

How radioactive isotopes are used in biological research

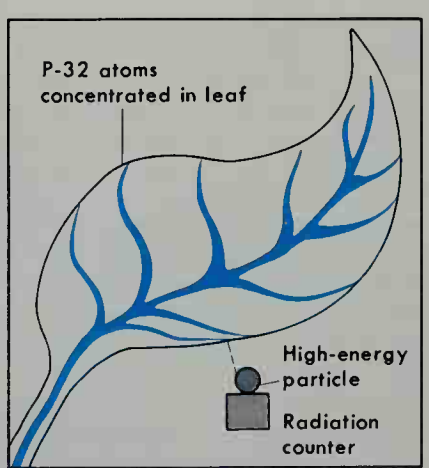
Radioactive isotopes are used as *tracers* in the study of biological processes and systems. The diagrams below show how phosphorus 32 is traced through the tissues of a plant.



A solution containing phosphorus is injected into a plant's roots. Radioactive phosphorus isotopes are mixed with ordinary phosphorus in the solution. Both isotopes move into the stem and leaves.



Each phosphorus isotope combines with the atoms of other substances in the plant. P-32 has the same chemical properties as P-31, and so it reacts in the same way when absorbed.



WORLD BOOK diagrams

A radiation counter enables researchers to trace the path of the P-32 atoms by measuring the high-energy particles they emit. The instrument can pinpoint concentrations of radioactive materials.

Steven Lucas, Southern Stock Photos

Jerusalem is Israel's capital and largest city. This photograph shows West Jerusalem, the more modern section that is home to most of the city's Jewish population.

Israel

Israel is a small country in southwestern Asia. It occupies a narrow strip of land on the eastern shore of the Mediterranean Sea. Israel was founded in 1948 as a homeland for Jews from all parts of the world, and more than 4 out of 5 of its people are Jews. Even Jews who live elsewhere consider Israel their spiritual home. Almost all the non-Jews in Israel are Arabs. Jerusalem is Israel's capital and largest city.

Israel makes up most of the Biblical Holy Land, the place where the religious and national identity of the Jews developed. According to the Bible, Abraham, the father of the Jewish people, established a Semitic population in the Holy Land. Many scholars believe this happened sometime between 1800 and 1500 B.C.

Eventually this land fell to a series of conquerors, including—in 63 B.C.—the Romans. Following unsuccessful Jewish revolts against Roman rule in A.D. 66-70 and A.D. 132-135, the Romans forced most of the Jews to leave. The Romans then began to call this region by the word that became *Palestine* in English. Palestine was ruled by the Roman and then the Byzantine empires until the A.D. 600's, when Arabs conquered the region. From that time until the mid-1900's, the majority of people in Palestine were Arabs. For more information on the ancient history of Israel, see the **Palestine** article.

In the late 1800's, European Jews formed a movement called Zionism, which sought to establish a Jewish state in Palestine. Jewish immigrants began arriving in Palestine in large numbers, and by the early 1900's friction had developed between the Jewish and Arab populations. In 1947, the United Nations (UN) proposed dividing the region into an Arab state and a Jewish state.

On May 14, 1948, the nation of Israel officially came into being. The surrounding Arab nations immediately attacked the new state, in the first of several Arab-Israeli wars. In 1967, at the end of one of the Arab-Israeli wars, Israeli troops occupied the Gaza Strip and the West Bank—territories that are home to millions of Palestinian Arabs. Israel's occupation of these territories further

Bernard Reich, the contributor of this article, is Professor of Political Science and International Affairs at George Washington University.

Facts in brief

Capital: Jerusalem.
Official languages: Hebrew and Arabic.
Area: 8,130 mi² (21,056 km²), not including 2,700 mi² (7,000 km²) of Arab territory occupied since 1967. *Greatest distances*—north-south, 260 mi (420 km); east-west, 70 mi (110 km). *Coastline*—170 mi (273 km).
Elevation: *Highest*—Mount Meron, 3,963 ft (1,208 m) above sea level. *Lowest*—shore of the Dead Sea, about 1,310 ft (399 m) below sea level.
Population: *Estimated 2002 population*—6,425,000; density, 790 per mi² (305 per km²); distribution, 90 percent urban, 10 percent rural. *1995 census*—5,548,523. Population figures do not include people living in occupied Arab territories, except for Israeli citizens.
Chief products: *Agriculture*—citrus and other fruits, cotton, eggs, grains, poultry, vegetables. *Manufacturing*—chemical products, electronic equipment, fertilizer, finished diamonds, paper, plastics, processed foods, scientific and optical instruments, textiles and clothing. *Mining*—potash, bromine, salt, phosphates.
National anthem: "Hatikva" ("The Hope").
Money: *Basic unit*—shekel. One hundred agorot equal one shekel.

inflamed Arab-Israeli tensions. In the 1990's, Israeli troops withdrew from most of the Gaza Strip and portions of the West Bank. The withdrawals were part of agreements with the Palestine Liberation Organization (PLO), which represents Palestinian Arabs. In the early 2000's, however, violent clashes between Palestinians and Israelis interrupted the peace process. For more details, see the *Recent developments* section of this article.

Israel has few natural resources and imports more goods than it exports. Still, it has achieved a relatively high standard of living. Almost all of its adults can read and write, and the level of unemployment is low. For Israel's literacy rate, see Literacy (table: Literacy rates). Jewish settlers have established major industries, drained swamps, and irrigated deserts.

Although it is a small country, Israel has a diverse terrain that includes mountains, deserts, seashores, and valleys. Israel has a pleasant climate, with hot, dry summers, and cool, mild winters.

Government

National government. Israel is a democratic republic. It has no written constitution. Instead, the government follows "basic laws" that have been passed by the Knesset, the Israeli parliament. The Knesset is a one-house body made up of 120 members, each elected to a term not to exceed four years. The Knesset passes legislation, participates in the formation of national policy, and approves budgets and taxes.

All Israeli citizens 18 years or older may vote. Voters do not cast ballots for individual candidates in Knesset elections. Instead, they vote for a *party list* that includes all candidates of a particular party. The list may range from one candidate to a full slate of 120 candidates. Elections are decided by the percentage of the vote received by each list. For example, if a certain party list received 33 percent of the vote, it would get 40 Knesset seats.

The prime minister is the head of Israel's government and normally the leader of the party with the most Knesset seats. The prime minister must maintain the support of a majority of Knesset members to stay in office. He or she forms and heads the Cabinet, Israel's top policymaking body. The Knesset must approve Cabinet appointments. The prime minister determines the topics of Cabinet meetings and has the final word in policy decisions.

In 1992, a law was passed allowing voters to directly elect the prime minister. Direct elections for prime minister were held in 1996, 1999, and 2001. Israel abandoned the direct election system after the 2001 election.

The president functions as the head of state. The Knesset elects the president to a seven-year term. Most of the president's duties are ceremonial.

Local government. Elected councils are the units of local government in Israel. Municipal councils serve the larger cities, and local councils govern the smaller urban areas. Regional councils serve rural areas. Councils are responsible for providing education, health and sanitation services, water, road maintenance, fire protection, and park and recreation facilities. They also set and collect local taxes and fees.

The national government divides the country into 6 administrative districts and 14 subdistricts. The minister of interior, one of the Cabinet members, appoints officials to head the districts and subdistricts. These officials oversee and approve the actions of the councils.

Politics. Israel has many political parties, representing a wide range of views. But two parties—the Labor Party and the Likud bloc—dominate national elections.

The Labor Party is a moderate party that has tended to support some government control of the economy. The party favors a negotiated settlement with the Arab states. The Likud bloc is an alliance of several smaller groups. It supports a limited government role in the economy and a more hard-line policy toward the Arab states.

Israel also has a number of smaller religious and special-interest parties. Each of these parties focuses on a particular subject or theme. If one of the major parties

Israel's flag shows the Star of David, an ancient Jewish symbol. The colors are those of a *tallit* (prayer shawl).

Coat of arms shows the *Menorah* (ancient holy candleholder) and olive branches. Hebrew letters spell Israel.

Israel Government Tourist Bureau

The Knesset Building, home of the Israeli parliament, glows in floodlights at night. It stands on a low hill in Jerusalem.

WORLD BOOK map

Israel is bordered by Jordan, Lebanon, Syria, and Egypt. Its western coast lies on the Mediterranean Sea.

controls too few seats in the Knesset to form a majority, it usually seeks support from other parties, including the religious parties. These parties thus have considerable power.

Courts. Israel's court system consists of both religious and *secular* (nonreligious) courts. The Supreme Court is the country's highest secular court. The secular court system also includes magistrate, district, municipal, and specialized courts. The Supreme Court hears appeals from these courts and acts to protect the rights of Israeli citizens.

Religious courts hear cases involving certain personal matters, such as marriage problems, divorces, alimony settlements, and inheritances. Jews, Christians, Muslims, and Druses each have their own religious courts.

Most religious court justices and all secular court justices are appointed by the president. The appointments are based on recommendations that are made by nomination committees consisting of officials from all branches of the Israeli government. Justices must retire at age 70.

Armed forces. Because of its conflicts with Arab states, Israel has maintained a strong military. However, the large amount of money Israel spends on defense puts a strain on the nation's economy.

Israel's army, navy, and air force have about 175,000 members. The country requires almost all Jewish men and most unmarried Jewish women to enter the military at age 18. Men must serve for three years, and women for two years. Annual reserve service is required of both men and women.

People

When Israel was established in 1948, it had about 806,000 people. Today, the population is about 6 million. The area along the Mediterranean coast is Israel's most densely populated region. The Negev Desert, in southwestern Israel, is the least densely populated region.

Jews. About 82 percent of Israel's people are Jews. The modern state of Israel was created as a homeland for the Jewish people. Since 1948, as many as 2 $\frac{1}{2}$ million Jews have migrated to Israel, many to escape persecution in their home countries. In 1950, the Knesset passed the Law of Return, which allows any Jew, with a few minor exceptions, to settle in Israel. A 1970 amendment to this law defined a Jew as "a person who was born of a Jewish mother or has become converted to Judaism and who is not a member of another religion." The Israeli government provides temporary housing and job training to immigrants.

Israel's Jewish population shares a common spiritual and historical heritage. But because they have come from many countries, Israel's Jews belong to a number of different *ethnic groups,* each with its own cultural, political, and recent historical background.

The two main groups in Israel's Jewish population have traditionally been the *Ashkenazim* and the *Sephardim,* or *Orientals.* The Ashkenazim, who came to Israel from Europe and North America, are descended from Jewish communities in central and eastern Europe. The Sephardim immigrated from the Middle East and the Mediterranean. Today, the designations *Ashkenazim* and *Sephardim* are less important because there are many Jews who immigrated from other areas, or who grew up in Israel. At the time of independence, most Jews were Ashkenazim. As a result, Israel's political, educational, and economic systems are primarily Western in orientation. Israel's Sephardic population has had to adapt to this society.

Arabs make up nearly all of the remaining 18 percent of the population of Israel. Most are Palestinians whose families remained in Israel after the 1948-1949 Arab-Israeli war. They usually live in their own farm villages or in the Arab neighborhoods of Israeli cities.

The nation's Jewish and Arab communities are often suspicious of one another, and Arab and Jewish Israelis have limited contact. Most Arabs and Jews live in separate areas, attend separate schools, speak different languages, and follow different cultural traditions.

Language. Israel has two official languages—Hebrew, the language spoken by most of the Jewish population, and Arabic, spoken mainly by the Arabs. Many Israelis also speak English. Many Ashkenazi Jews speak *Yiddish,* a Germanic language that developed in the Jewish communities of Europe. Immigrants from the former Soviet Union speak Russian.

Way of life

Israel has a relatively high standard of living, with income levels similar to those in such European countries

Alex Borodulin, De Wys, Inc.

Modern apartment buildings, such as these in Tel Aviv, are common in Israeli cities. Most urban Israelis live in apartments.

© Richard Lobell

A moshav in the Galilee region of Israel houses several rural families. Moshavim are cooperative farming communities.

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School attendance is required of all Israelis from the ages of 5 to 16, with free education provided through age 18. The students above are attending class at a rural high school.

as Spain or Greece. Israel's life expectancy levels rank among the highest in the world. The country has an excellent system of health and medical care.

City life. Many of Israel's cities are built on ancient sites and include historic buildings, but they also have large, modern sections built by Jewish settlers during the mid-1900's. Many of the cities feature high-rise apartment and office buildings. Most urban Israelis live in apartments. Like urban areas in most countries, Israel's major cities face problems brought on by rapid growth. Roads, housing, and municipal services sometimes fail to keep pace with the expanding population. Traffic congestion and, to a lesser degree, pollution have become problems in Israel's larger cities.

Jerusalem, the capital and largest city, is the spiritual center of the Jewish religion. It is also a holy city of Christians and Muslims. The city is divided into three sections—the Old City, West Jerusalem, and East Jerusalem. All three sections contain many ancient holy places, but the Old City is the historical heart of Jerusalem. It occupies much of the area that was inhabited during Biblical times. West Jerusalem, inhabited mainly by Jews, is the newer part of the city. It contains concrete apartment houses and modern public buildings. It also has several ancient holy places. East Jerusalem, which was captured by Israel in 1967, is inhabited mainly by Arabs. See **Jerusalem**.

Tel Aviv, Israel's second largest city in size and importance, serves as the nation's commercial, financial, and industrial center. Haifa is Israel's major port city and the administrative and industrial center of northern Israel. Beersheba is the most important city in the Negev Desert region.

In the 1950's, the Israeli government began creating "development towns." These towns, which include Arad and Karmiel, were established to attract industry to lightly populated parts of Israel and to provide homes for new immigrants.

Rural life. Many people in rural areas of Israel live in *collective* or *cooperative* communities. In a collective community, called a *kibbutz,* members receive food, housing, education, child care, and medical care in exchange for labor. All property is shared. The kibbutz was originally agricultural, but many now engage primarily in industrial activity. In a cooperative community, called a *moshav,* each family works its land separately and has its own living quarters. The village administration provides the family's equipment and supplies, and markets its produce.

Clothing. Most Israelis wear Western-style clothing, although styles in Israel are generally less formal than they are in Western countries. However, some Israelis still dress in the traditional clothing of their ethnic or religious group.

Food and drink. Israel's food and drink reflect the ethnic diversity of its population. Traditional European Jewish dishes, such as chopped liver, chicken soup, and gefilte fish, are common. But so also are traditional Middle Eastern foods such as *felafel*—small, deep-fried patties of ground chickpeas. Raw vegetables and fruits are among the most popular foods.

All government buildings and most hotels and restaurants serve only *kosher* foods, which are prepared according to Jewish dietary laws (see **Kosher**). But there are nonkosher restaurants as well. Israel also has fast-food restaurants, which serve local dishes in addition to Western foods. Popular beverages in Israel include Turkish coffee, cola, beer, and wine.

Religion. Israeli law guarantees religious freedom and allows members of all faiths to have days of rest on their Sabbath and holy days. Many public facilities are closed on the Jewish Sabbath—from sunset Friday to sunset Saturday.

About one-fifth of Israel's Jewish population strictly observe the principles of Judaism. These people are called *Orthodox* Jews. About half of the country's Jews observe some of the principles. The rest are *secular,* or nonreligious. Israel's Jews disagree on the proper relationship between religion and the state. Orthodox Jews tend to believe that Jewish religious values should play an important role in shaping government policy. But many other members of the Jewish population, including almost all secular Jews, seek to limit the role of religion in the state.

About 75 percent of Israel's non-Jewish populace are Arab Muslims, most of whom follow the Sunni division of Islam (see **Islam** [Divisions of Islam]). About 10 percent of the non-Jews are Arab Christians, mostly Eastern Catholic and Eastern Orthodox. Most of the remaining 15 percent are Druses, an Arabic-speaking people who follow a religion that developed out of Islam. A few of the non-Jewish people are members of the Bahá'ís or other smaller religious communities.

Education. Education is given a high priority in Israel. One of the first laws passed in Israel established free education and required school attendance for all children from the ages of 5 to 14. Attendance is now required to age 16.

Israeli children normally attend one year of nursery school, one year of kindergarten, six years of elementary school, three years of junior high school, and three years of high school. Education is free until age 18.

Israel has a Jewish school system in which instruction

is in Hebrew, and an Arab/Druse school system in which instruction is in Arabic. The government recognizes and funds both systems.

The Jewish system consists of state schools, state-religious schools, and independent religious schools. State and state-religious schools offer similar academic programs, but state-religious schools emphasize Jewish studies. Independent religious schools are affiliated with Orthodox Judaism and offer more intensive religious instruction.

The Arab/Druse school system includes separate schools for Arab and Druse students. These schools emphasize Arab or Druse history and culture. The Arab schools also provide religious instruction in Islam or Christianity. In Druse schools, community elders choose whether or not to provide religious training.

Israel has a number of institutions of higher education. They include Bar-Ilan University, Ben Gurion University of the Negev, Haifa University, Hebrew University of Jerusalem, Technion-Israel Institute of Technology, Tel Aviv University, and Weizmann Institute of Science.

The arts. In music, dance, theater, literature, painting, and sculpture, many Israeli artists work within the traditions of their ethnic group. Other artists have blended different cultural art forms to create a uniquely Israeli artistic tradition. The arts in Israel not only reflect the country's immigrant diversity, they also draw upon Jewish history and religion and address the social and political problems of modern Israel.

The number of books published per person in Israel is among the highest in the world. Most Israeli authors write in Hebrew, and some have achieved international fame. Shmuel Yosef Agnon, a novelist and short-story writer, shared the 1966 Nobel Prize for literature. Other important writers have included Chaim Nachman Bialik, Saul Tchernichovsky, Amos Oz, and A. B. Yehoshua.

Israel has several theatrical companies. *Habimah,* the national theater, was founded in Moscow in 1917. It moved permanently to Tel Aviv in 1932. The Israel Philharmonic Orchestra performs throughout Israel and often tours abroad. Jerusalem has a symphony orchestra. Israel also has several professional ballet and modern dance companies. Haifa and Tel Aviv boast a number of outstanding museums.

The land

Israel has four major land regions. They are (1) the Coastal Plain, (2) the Judeo-Galilean Highlands, (3) the Rift Valley, and (4) the Negev Desert.

The Coastal Plain is a narrow strip of fertile land along the Mediterranean Sea. Most Israelis live in the Coastal Plain, and most of the nation's industry and agriculture are located there. Haifa, Israel's major port, is on the northern coast. The northern part of the Coastal Plain includes part of the fertile Plain of Esdraelon. The Qishon, a broad stream, flows through this plain. Most of Israel's important citrus crop is produced in the Plain of Sharon, which forms part of the central Coastal Plain. Farther south is the city of Tel Aviv.

The Judeo-Galilean Highlands include a series of mountain ranges that run from Galilee—the northernmost part of Israel—to the edge of the Negev Desert in the south. The southern part of the highlands includes the West Bank.

The mountains of Galilee stretch southward to the Plain of Esdraelon. Galilee is the home of most of Israel's Arabs and includes the city of Nazareth, the largest Arab center. Galilee also contains the highest mountain in Israel, 3,963-foot (1,208-meter) Mount Meron.

Jerusalem is located in the northern part of the Judean Hills. Rural residents of these hills farm on the hillsides and in the broad valleys. The land to the south is more rugged and agriculture is limited to grazing.

The Rift Valley is a long, narrow strip of land in far eastern Israel. It makes up a small part of the Great Rift Valley, a series of valleys that extends from Syria to Mozambique (see **Great Rift Valley**).

The edges of the Rift Valley are steep, but the floor is largely flat. Much of the region lies below sea level. The region includes the Dead Sea, a saltwater lake. The shore of the Dead Sea lies about 1,310 feet (399 meters) below sea level—the lowest land area on earth.

Few areas of the Rift Valley are fertile. The most fertile section is about 10 miles (16 kilometers) north of the Sea

Frank Folwell, Click/Chicago

A group of Orthodox Jews in Jerusalem read the *Torah,* the first five books of the Bible. Orthodox Jews strictly observe the principles of Judaism. They make up about one-fifth of Israel's Jewish population.

Israel map index

Cities and towns

Afula	33,000	C	5
Akko	45,100	B	4
Arad	18,300	F	4
Arara*	10,500	C	4
Arraba*	13,400	B	5
Ashdod	110,300	E	3
Ashqelon	73,300	E	3
Azor*	7,700	D	3
Baqa el Gharbiyya	15,400	C	4
Bat Yam	143,200	D	3
Beersheba	141,400	F	3
Bene Beraq	125,000	D	3
Bet Shean	14,800	C	5
Bet Shemesh	20,900	E	4
Daliyat el Karmel*	11,000	C	4
Dimona	30,000	G	4
Elat	33,300	K	4
Er Reina*	10,300	B	5
Et Taiyiba	23,000	D	4
Et Tira	15,000	D	4
Ganne Tiqwa*	9,400	D	3
Gedera	9,700	E	3
Givat Shemuel*	10,700	D	3
Givatayim*	47,200	D	3
Hadera	55,100	C	4
Haifa	246,500	B	4
Hazor	8,200	B	5
Herzliyya	82,700	D	3
Hod HaSharon*	27,700	D	4
Holon	162,800	D	3
Ibillin*	7,900	B	4
Iksal*	7,600	B	5
Isfiya*	8,100	B	4
Jerusalem	567,100	E	4
Kafr Kanna*	11,900	B	5
Kafr Manda*	10,000	B	5
Kafr Qari*	10,100	C	4
Kafr Qasim*	11,400	D	4
Kafr Yasif*	6,600	B	4
Karmiel	30,800	B	5
Kefar Ata	41,800	B	4
Kefar Sava	65,800	D	4
Lod	49,500	D	4
Maalot-Tarshiha	12,800	A	4
Maghar	14,400	B	5
Majd el Kurum*	8,400	B	4
Mevasseret Ziyyon	14,400	E	4
Migdal Ha Emeq	20,100	B	4
Nahariyya	37,100	A	4
Nazareth	52,200	B	5
Nazerat Illit*	35,200	B	4
Nes Ziyyona	21,800	D	3
Nesher*	15,000	B	4
Netivot	13,600	F	3
Netanya	142,700	C	3
Ofaqim	18,800	F	3
Or Aqiva	11,500	C	4
Or Yehuda*	33,300	D	3
Pardes Hanna	19,400	C	4
Petah Tiqwa	151,100	D	4
Qalansuwa*	11,200	C	4
Qiryat Ata, see Kefar Ata			
Qiryat Bialik	35,300	B	4
Qiryat-Gat	38,300	E	3
Qiryat-Malakhi	18,600	E	3
Qiryat Motzkin	33,400	B	4
Qiryat Ono	23,800	D	4
Qiryat-Shemona	19,000	A	5
Qiryat Tivon	12,500	B	4
Qiryat Yam	40,300	B	4
Raananna	56,900	D	3
Ramat Gan	122,800	D	3
Ramat Ha-Sharon	37,000	D	3
Ramla	55,500	D	4
Rehovot	83,200	E	3
Rishon LeZiyyon	154,300	D	3
Rosh HaAyin*	17,800	D	4
Sakhnin	17,800	B	5
Sederot	14,600	F	3
Shefaram	22,800	B	4
Tamra	17,900	B	4
Tel Aviv	357,400	D	3
Tiberias	35,900	B	5
Tirat Karmel	17,200	B	4
Turan*	8,000	B	5
Umm el Fahm	28,100	C	4
Yavne	25,600	E	3
Yehud*	17,300	D	4
Yeroham	6,800	G	4
Yirka*	9,100	B	4
Zefat	21,200	B	5

*Does not appear on map; key shows general location.
Source: 1993 official estimates.

WORLD BOOK map

Physical features

Bay of Haifa	A	2	Mount Carmel	B	2
Besor (stream)	E	1	Mount Meron	A	3
Dead Sea	E	3	Mount Ramon	F	2
Gulf of Aqaba	H	2	Mount Tabor	B	3
Ha Arava (depression)	F	3	Plain of Esdraelon	B	2
Jezreel Valley	B	2	Plain of Sharon	B	2
Jordan River	A	3	Qishon (stream)	B	2
Lake Hula	A	3	Sea of Galilee	B	3
Mediterranean Sea	B	1	Yarqon (stream)	C	2

Richard Lobell

The Negev Desert in southern Israel is the nation's driest region, receiving an average yearly rainfall of only 1 inch (25 millimeters). Irrigation is used to cultivate some parts of the Negev.

of Galilee. There, during the 1950's, Israel drained Lake Hula and nearby swamps to create about 15,000 acres (6,100 hectares) of farmland.

The Jordan River, the longest of Israel's few rivers, flows through the northern Rift Valley. It travels through the Sea of Galilee and empties into the Dead Sea.

The Negev Desert, Israel's driest region, is an arid area of flatlands and mountains. The Negev has traditionally been used for grazing because its limited rainfall cannot support crops. But sections of the Negev are being brought under cultivation by means of irrigation. Water from the Sea of Galilee is pumped southward through the National Water Carrier, an extensive system of canals, pipelines, and tunnels. Regional systems connect with the carrier and extend to the northern Negev.

Climate

Israel has hot, dry summers and cool, mild winters. The climate varies somewhat from region to region, partly because of altitude. Temperatures are generally cooler at higher altitudes and warmer at lower altitudes. In August, the hottest month, the temperature may reach 98 °F (37 °C) in the hilly regions and as high as 120 °F (49 °C) near the Dead Sea. July temperatures average 85 °F (31 °C) in Jerusalem and 82 °F (28 °C) in Tel Aviv. In January, the coldest month, temperatures average 55 °F (13 °C) in Jerusalem and 64 °F (18 °C) in Tel Aviv.

Israel has almost continuous sunshine from May through mid-October. A hot, dry, dusty wind called the *khamsin* sometimes blows in from deserts to the east, particularly in the spring and fall.

Almost all of Israel's rain falls between November and March, much of it in December. There are great regional variations in rainfall. In general, rainfall declines from north to south and from west to east. In the driest area, the southern Negev Desert, the average yearly rainfall is only 1 inch (25 millimeters). In the wettest area, the hilly parts of Upper Galilee, average annual rainfall is 42 $\frac{1}{2}$

inches (1,080 millimeters). Brief snowfalls also sometimes occur in the hilly regions.

Economy

At independence, Israel was a poor country with little agricultural or industrial production. But Israel's economy has grown tremendously since 1948. The nation now enjoys a relatively high standard of living, despite having few natural resources and a limited water supply.

Many immigrants came to Israel in the years immediately after independence. Many of these immigrants were skilled laborers and professionals who greatly aided the nation's economic development. Financial assistance from Western nations, especially the United States, is also vital to Israel's economic well-being.

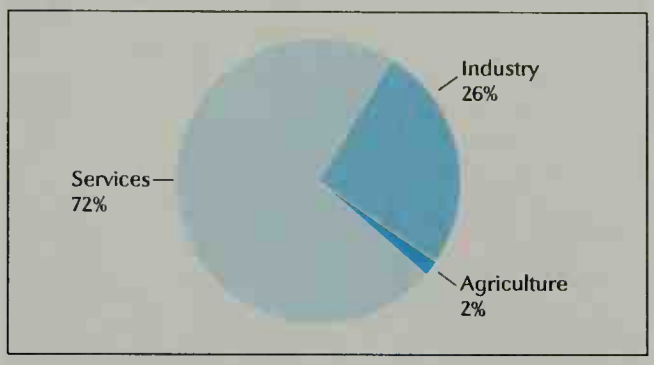
About half of the businesses in Israel are privately owned, and a fourth are owned by the government. The Histadrut (General Federation of Labor), a powerful organization of labor unions, also owns about a fourth of the businesses, farms, and industries.

Service industries—economic activities that produce services, not goods—account for about three-fourths of Israel's gross domestic product (GDP). GDP is the value of all goods and services produced yearly within the country. Service industries employ about two-thirds of Israel's workers. Many of Israel's service industry workers are employed by the government or by businesses owned by the government. Government workers provide many of the services that are needed by Israel's large immigrant population, such as housing, education, and vocational training. Tourist activities support many of Israel's service industries, especially trade, restaurants, and hotels.

Manufacturing accounts for 17 percent of Israel's GDP and employs 22 percent of its work force. Israeli factories produce such goods as chemical products, electronic equipment, fertilizer, paper, plastics, processed foods, scientific and optical instruments, and textiles and clothing. The cutting of imported diamonds is a major industry. Government-owned plants manufacture equipment used by Israel's large armed forces. Tel Aviv and Haifa are Israel's major manufacturing centers.

Agriculture accounts for 2 percent of Israel's GDP and employs about 3 percent of its workers. Agriculture formerly employed a much larger percentage of Israel's work force. But much of the work once performed by people is now performed by machines. Important agricultural products include citrus and other fruits, eggs,

Israel's gross domestic product



Israel's gross domestic product (GDP) was $86,585,000,000 in United States dollars in 1995. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, social, and personal services; finance, insurance, and real estate; government; trade; transportation and communication; and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, forestry, and fishing.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers	
		Number of persons	Percent of total
Finance, insurance, real estate, & business services	26	244,000	13
Government	24	*	*
Manufacturing & Mining	17	404,100	22
Trade, restaurants, & hotels	11	248,600	13
Construction	8	140,600	8
Transportation & communication	6	114,900	6
Community, social, & personal services	4	640,500	34
Agriculture, forestry & fishing	2	57,400	3
Utilities	2	19,100	1
Total	100	1,869,200	100

*Included in Community, social, & personal services.
Figures are for 1995.
Sources: International Labour Organization; United Nations.

© Louis Goldman, Photo Researchers

Olive groves grow north of the Sea of Galilee in the Rift Valley, a long, narrow lowland in far eastern Israel.

Cameramann International, Ltd.

A mineral recovery plant removes such compounds as bromine, potash, and salt from the waters of the Dead Sea. The Dead Sea is Israel's leading source of minerals.

grain, poultry, and vegetables.

The government develops, helps finance, and controls agricultural activity, including fishing and forestry. Israel produces most of the food needed to feed its people. Agricultural exports provide enough income to pay for any necessary food imports. Most Israeli farmers use modern agricultural methods. Water drawn from the Jordan River irrigates large amounts of land in Israel.

Most Israeli farms are organized as moshavim or kibbutzim (see the *Rural life* section of this article). Israel also has some private farms, mostly owned by Arabs.

Mining. The Dead Sea, the world's saltiest body of water, is Israel's leading mineral source. Compounds drawn from the sea yield bromine, magnesium, potash, and table salt. Potash, used chiefly in fertilizers, is the most important mineral. Phosphates, copper, clay, and gypsum are mined in the Negev Desert.

Energy sources. Israel is poor in energy sources. It has no coal deposits or hydroelectric power resources and only small amounts of crude oil and natural gas. As a result, Israel depends primarily on imported crude oil and coal to meet its energy needs.

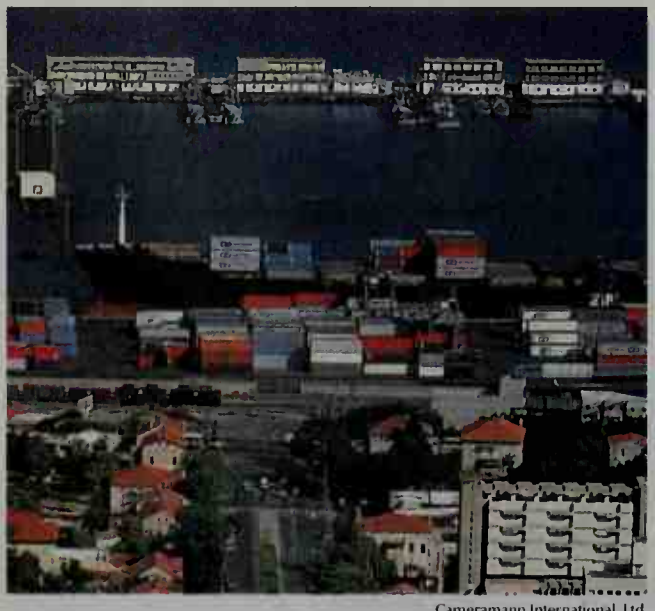
International trade. Because it has few natural resources, Israel imports more goods than it exports. The country's chief imports include chemicals, computer equipment, grain, iron and steel, military equipment, petroleum products, rough diamonds, and textiles. Israel's main exports are chemical products, citrus fruits, clothing, electronic equipment, fertilizers, polished diamonds, and processed foods. The nation's main trading partners include the Benelux countries (Belgium, the Netherlands, and Luxembourg), Germany, Italy, Switzerland, the United Kingdom, and the United States.

Transportation and communication. Israel has a well-developed transportation system. This system developed in part because of the need to move military troops and equipment quickly to any part of the country.

Most middle-class Israeli families either own an automobile or have one provided by their employer. Overall, Israel has about one car for every five people. Paved roads reach almost all parts of the country. Public transportation both in and between cities is provided primarily by bus. Most rail lines in Israel haul freight.

Ben-Gurion Airport, Israel's international terminal, is located at Lod, near Tel Aviv. Smaller airports are located at Atarot, near Jerusalem, and at Elat. El Al, Israel's international airline, flies regularly to the United States, Canada, Europe, and parts of Africa and Asia. Israel has three major deepwater ports—Haifa, Ashdod, and Elat.

Israel's communication system is one of the best in the Middle East. Israel has about 30 daily newspapers, about half of which are in Hebrew. The rest are in Arabic, Yiddish, or one of several foreign languages. The Israel Broadcasting Authority, a public corporation set up by the government, runs the TV and nonmilitary radio stations. Israelis own about one TV set for every four people, and one radio for every two people.



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Haifa's deepwater harbor has made this city Israel's chief port and a center of international trade.

History

For detailed information on the early history of what is now Israel, see **Palestine**. See also **Zionism**.

Beginnings of a new state. In the mid-1800's, Eastern European Jews began to develop a desire to live in the Holy Land. By 1880, about 24,000 Jews were living in Palestine, which was controlled by the Ottoman Empire. In the late 1800's, oppression of Jews in eastern Europe triggered the Zionist movement and eventually led to a mass emigration of Jews to Palestine. By 1914, there were about 85,000 Jews in Palestine, out of a total population of about 700,000.

In 1917, during World War I, the United Kingdom issued the Balfour Declaration, which expressed British support for a national homeland for the Jews in Palestine. The United Kingdom was fighting to win control of Palestine from the Ottoman Empire as part of the war. The British hoped the declaration would rally Jewish leaders in the United Kingdom and the United States to support the British war efforts. At the same time, however, the British promised independence to various Arab

groups in the Middle East, hoping to gain their support against the Ottomans. The promises were vague, but Arab leaders assumed they included Palestine.

After the Ottoman defeat in World War I, the League of Nations made Palestine a mandated territory of the United Kingdom (see Mandated territory). According to the mandate, the British were to help Palestinian Jews build a national home. Many Zionists viewed the mandate as support for increased Jewish immigration to Palestine. But the British, fearful of the hostility of the large Arab population, proposed limits on Jewish immigration. But these limitations were not fully enforced.

Large numbers of European Jews came to Palestine in the 1930's to escape persecution by the Nazis. Alarmed by the Jewish immigration, the Palestinian Arabs revolted against British rule during the late 1930's. In 1939, the United Kingdom began attempting to limit Jewish immigration to Palestine. Jews strongly opposed this policy.

During World War II (1939-1945), the Nazis killed about 6 million European Jews. This led to increased demands for a Jewish state, but the British continued to limit Jewish immigration to Palestine. In 1947, the United Kingdom submitted the issue to the United Nations (UN).

Independence and conflict. On Nov. 29, 1947, the UN General Assembly agreed to divide Palestine into an Arab state and a Jewish state and to place Jerusalem under international control. The Jews in Palestine accepted this plan, but the Arabs rejected it. Fighting broke out immediately.

Israel officially came into existence on May 14, 1948, under the leadership of David Ben-Gurion. On May 15, Arab armies, chiefly from Egypt, Syria, Lebanon, Iraq, and Transjordan (which became known as Jordan in 1949), attacked Israel, aiming to destroy the new nation. By early 1949, Israel had defeated the Arabs and gained control of about half the land planned for the new Arab state. Egypt and Jordan held the rest of Palestine. Israel controlled the western half of Jerusalem, and Jordan held the eastern half. Israel incorporated the gained territory into the new country, adding about 150,000 resentful Arabs to its population. Hundreds of thousands of other Palestinian Arabs settled as refugees in parts of Palestine not under Israeli control and in Arab countries.

AP/Wide World

Jewish immigrants began flocking to Israel after the nation was created in 1948. Israel opened its doors to Jews from anywhere in the world.

By mid-1949, Israel had signed armistice agreements with Egypt, Syria, Jordan, and Lebanon. But formal peace treaties were not signed because the Arab nations refused to recognize the existence of Israel.

Israel held its first election in January 1949. In February, the Knesset elected Chaim Weizmann president. He officially appointed Ben-Gurion prime minister.

The Sinai invasion. Border clashes between Arab and Israeli troops occurred frequently in the early 1950's. In the mid-1950's, Egypt began giving financial aid and military supplies to Palestinian Arab *fedayeen* (com-

In the 1948 war, Israel gained much territory in addition to the area that had been given to it by the United Nations (UN) Partition Plan of 1947.

The 1967 war resulted in Israel's occupation of Egypt's Sinai Peninsula and Syria's Golan Heights, and of the West Bank and Gaza Strip.

WORLD BOOK maps

Israel withdrew from the Sinai Peninsula, most of the Gaza Strip, and portions of the West Bank in a number of stages, beginning in 1975.

mandos). The fedayeen raided Israel from the Gaza Strip, the Egyptian-occupied part of Palestine. The Israelis raided the Gaza Strip in return. Egypt also blocked Israeli ships from using the Suez Canal and stopped Israeli ships at the entrance to the Gulf of Aqaba. In July 1956, Egypt nationalized the Suez Canal, which at the time was owned mainly by the United Kingdom and France.

In response to the Egyptian actions, on Oct. 29, 1956, Israeli forces invaded Egypt. The United Kingdom and France attacked Egypt two days later. By November 5, the Israelis occupied the Gaza Strip and the Sinai Peninsula, and the British and French controlled the northern entrance to the Suez Canal. The UN ended the fighting and arranged the withdrawal of foreign troops from Egyptian territory. The UN also set up a peacekeeping force in the Gaza Strip and Sinai Peninsula.

The Six-Day War. In May 1967, the UN removed its peacekeeping force from the Gaza Strip and Sinai Peninsula in response to demands by Egyptian President Gamal Abdel Nasser. Nasser then sent large numbers of troops into the Sinai. He also announced the closing of the Strait of Tiran to Israeli ships, thus blocking the Israeli port of Elat.

Fearing that Arabs would soon attack, Israel launched a surprise air strike against Egypt on June 5, 1967. Syria, Jordan, and Iraq, which had signed defense agreements with Egypt, immediately joined in the fighting. In one day, Israeli planes almost completely destroyed the Arab air forces. Israel's ground forces then defeated those of the Arab states. The UN arranged a cease-fire, ending the war after six days.

At the war's conclusion, Israel held the Sinai Peninsula and Gaza Strip, as well as Syria's Golan Heights. It also occupied the West Bank, which had been claimed by Jordan. Israel vowed not to withdraw from these territories until the Arab states recognized Israel's right to exist. In June 1967, Israel officially made the eastern half of Jerusalem part of Israel.

The Six-Day War again proved the superiority of Israel's military forces, but it also planted the seeds of additional Arab-Israeli problems. The occupation of the Gaza Strip and West Bank placed Israel in control of about 1 million hostile Palestinian inhabitants.

The rise of the PLO. Following the Six-Day War, the Palestine Liberation Organization (PLO) became prominent in the Middle East. The PLO is a confederation of Palestinian Arab groups that work to establish an Arab state in Palestine. It adopted guerrilla tactics, including terrorist attacks and commando raids against military and civilian targets.

After the defeat of the regular Arab armies in the 1967 war, Arab leaders began increasing their support of the PLO's forces. These forces then stepped up guerrilla activity against Israel. Israel retaliated with raids against PLO bases in neighboring Arab countries.

The Yom Kippur War. Israeli and Egyptian forces engaged in intense border fighting along the Suez Canal between April 1969 and August 1970. The Soviet Union provided military assistance to Egypt in the conflict, which was ended by a U.S.-sponsored cease-fire. On Oct. 6, 1973, full-scale war broke out again when Egyptian and Syrian forces attacked Israeli positions along the Suez Canal and in the Golan Heights. The attack occurred on Yom Kippur, the most sacred Jewish holy day. Israel pushed back the Arab forces. It recaptured the Golan Heights and some additional Syrian territory. A cease-fire went into effect on October 25.

The Yom Kippur War had far-reaching effects. The Israeli economy suffered severely. Although Israel won the war, it suffered heavy losses of men and equipment. Many Israelis criticized the government's handling of the conflict. As a result, Prime Minister Golda Meir resigned in April 1974. Yitzhak Rabin succeeded her in June. The war also greatly increased Israel's dependence on the United States, which supplied Israel with arms.

The Camp David Accords. The Labor Party and the party from which it developed, the Mapai, controlled Israel's government from independence until 1977. Under Israel's political system of the time, the prime minister was usually the leader of the party with the most seats in the Knesset. In 1977, parliamentary elections transferred control of the country to the Likud bloc. Menachem Begin, the Likud leader, became prime minister.

Israeli-Egyptian tensions eased after the Yom Kippur War. In November 1977, Egyptian President Anwar el-Sadat announced that he was ready to negotiate a peace settlement with Israel. That month, he met with Begin in Jerusalem. In September 1978, Begin, Sadat, and U.S. President Jimmy Carter met at Camp David in the United States for talks arranged by Carter. The talks resulted in the Camp David Accords, which focused on achieving two objectives: (1) peace between Egypt and Israel, and (2) a comprehensive peace in the Middle East.

The first objective of the Camp David Accords was met when Egypt and Israel signed a peace treaty in March 1979. In February 1980, they exchanged diplomats for the first time. Israel withdrew from Egypt's Sinai

Important dates in Israel

1917	The United Kingdom (U.K.) issued the Balfour Declaration, expressing its support for a Jewish homeland in Palestine.
1920	Palestine became a mandated territory of the U.K.
1947	The United Nations (UN) divided Palestine into a Jewish state and an Arab state.
1948	Israel came into existence on May 14.
1948	Egypt, Syria, Lebanon, Iraq, and Jordan attacked Israel on May 15, starting the first Arab-Israeli war. Israel defeated the Arabs and gained much territory.
1956	After Egypt nationalized the Suez Canal, Israel attacked Egypt, initiating the second Arab-Israeli war. The U.K. and France also attacked Egypt. The UN ended the fighting.
1967	Israel defeated Egypt, Jordan, and Syria in the Six-Day War. Israel captured the Sinai Peninsula, Gaza Strip, West Bank, and Golan Heights.
1972	Palestinian terrorists killed 11 Israeli athletes at the Summer Olympic Games in Munich, West Germany.
1973	Egypt and Syria attacked Israeli forces, starting the Yom Kippur War.
1978	Israel and Egypt signed the Camp David Accords, an agreement to end the dispute between the two countries.
1979	Egypt and Israel signed a peace treaty.
1982	Israel withdrew from the Sinai Peninsula.
1993	Israel and the Palestine Liberation Organization (PLO) signed an agreement to work to end their conflicts.
1994	As part of the 1993 PLO agreement, Israel withdrew from most of the Gaza Strip and the West Bank city of Jericho. Israel and Jordan signed a peace treaty.
1995	Prime Minister Yitzhak Rabin was assassinated on November 4.
2000	Violence erupted between Palestinians and Israelis, killing hundreds of people and interrupting the peace process.

Peninsula in 1982. No immediate progress was made in efforts to meet the second objective.

Invasion of Lebanon. Tensions between Israel and the PLO escalated in the late 1970's and early 1980's. In 1978, Israel invaded southern Lebanon in an attempt to drive out Palestinian terrorists who had been attacking Israel for several years. In June 1982, a large Israeli force attacked southern and central Lebanon in retaliation for PLO attacks on northern Israel. The PLO withdrew most of its forces from Lebanon in August 1982. In 1985, Israel withdrew its forces from all of Lebanon except a security zone along the Lebanon-Israeli border.

Unity government. Begin resigned as prime minister in September 1983. Yitzhak Shamir of the Likud bloc succeeded him. Parliamentary elections were held in July 1984. The Labor Party won more seats than the Likud bloc, but neither party won a majority and neither was able to form a coalition government. In September, Labor and Likud agreed to form a unity government for 50 months. Under the agreement, Shimon Peres, leader of the Labor Party, served as prime minister for a term of 25 months. Shamir served as vice prime minister and foreign minister. The roles of Peres and Shamir were reversed after 25 months, in October 1986.

The unity government included Cabinet members of both parties. It succeeded in reducing a high inflation rate in Israel. But the government was divided on how to attain peace with the Arabs. The Labor camp favored giving up portions of the occupied territories in return for peace agreements. The Likud bloc, however, supported the establishment of Jewish settlements in the territories and their retention by Israel.

In late 1987, Arabs in the Gaza Strip and the West Bank began staging widespread—often violent—demonstrations against Israel's occupation. Israeli troops killed a number of protesters during these demonstrations, which became known as the first *intifada* (an Arabic word for *uprising*). A few Israelis were also killed, and hundreds of Palestinians and Israelis were injured.

In November 1988, new parliamentary elections were held. The Likud bloc won one more seat than the Labor Party, but again neither party won a majority. In December, Likud and Labor formed a new coalition government with Shamir continuing as prime minister. In 1990, Shamir refused to compromise on peace plans for the occupied territories. The Labor Party then left the coalition, and the government fell in March. In June 1990, Likud and small conservative parties formed a new coalition government with Shamir as prime minister.

Recent developments. From the mid-1980's to the early 1990's, thousands of Ethiopian Jews moved to Israel. Also, hundreds of thousands of Soviet Jews moved there. The influx of newcomers led to problems in housing and employment. Israel continued to build new settlements in occupied territories, in part to accommodate the immigrants. Despite protests from Palestinians, Shamir and Likud backed these construction projects.

In August 1990, Iraq invaded Kuwait. In early 1991, the United States and other countries defeated Iraq in the Persian Gulf War. During the war, Iraq fired missiles at Israel. See **Persian Gulf War.**

In October 1991, peace talks began between Israel, Syria, Lebanon, and a joint Jordanian-Palestinian delegation. Israel's Labor Party gained control of the government in June 1992 elections. In July, Labor Party leader Yitzhak Rabin replaced Shamir as prime minister. Rabin agreed to limit construction of new Jewish settlements in the occupied territories as a step toward peace.

The PLO was not a participant in the peace talks that began in October 1991. But in September 1993, following secret talks in Oslo, Norway, Israel and the PLO recognized each other and signed an agreement that included steps to end their conflicts. As a result of this agreement and later ones, Israel withdrew its troops from most of the Gaza Strip and portions of the West Bank. Palestinians took control of these areas. In October 1994, Israel and Jordan signed a peace treaty that formally ended the state of war that had technically existed between the countries since 1948.

Not all Israelis agreed with the peace process, and some protested it. Some opponents argued, for example, that Israel was giving away land that should historically belong to it. On Nov. 4, 1995, Rabin was assassinated in Tel Aviv by a right-wing Israeli university student who was opposed to his policies. Peres, who had been foreign minister, became prime minister.

In 1996, Benjamin Netanyahu, the Likud leader and a critic of the Israeli-PLO peace agreements, defeated Peres in an election for prime minister. Tensions between Israel and the Palestinians grew after the 1996 elections. In 1996 and 1997, Israel announced plans to expand Israeli settlements in the West Bank and to build new Israeli housing in East Jerusalem. Both decisions met with angry and violent protests from the Palestinians.

In October 1998, Israel and the Palestinians signed the Wye River Memorandum. This accord called for Israel to turn over more of the West Bank to Palestinian control, and it allowed a Palestinian airport in the Gaza Strip to open. But in December, Netanyahu, claiming that the PLO was not fulfilling its security commitments, suspended Israeli troop withdrawals from the West Bank.

In May 1999, Ehud Barak, leader of the Labor Party, was elected prime minister of Israel. In September, Barak and Palestinian leader Yasir Arafat signed a new agreement that revived the previous Wye River Memorandum. Israel soon resumed its troop withdrawals.

G. E. Battel/M. Deville from Gamma/Liaison

A peace agreement signed in October 1994 formally ended a state of war that had technically existed between Israel and Jordan since 1948. At the signing ceremonies, Israeli Prime Minister Yitzhak Rabin, *left,* and King Hussein I of Jordan, *right,* shook hands while United States President Bill Clinton looked on.

In May 2000, Israel withdrew its troops from the security zone it had established in southern Lebanon. Hezbollah guerrillas took control of the area. Hezbollah, also spelled Hizbollah, is a movement that opposed the Israeli occupation of Lebanon. By September, UN peacekeepers and Lebanese security forces had moved into most of southern Lebanon. But Hezbollah remained in control of the area near the Israel-Lebanon border.

In July 2000, Barak and Arafat met for talks in the United States. The two sides were unable to agree on key issues, especially those involving control of Jerusalem. In September, Ariel Sharon, the Likud leader and a critic of the peace process, visited Temple Mount in Jerusalem. Temple Mount, known to Arabs as Haram al-Sharif, is a holy site for both Muslims and Jews. Israel and the Palestinians disagree about who should govern the site. Sharon's visit angered Palestinians, who began a second violent intifada against Israeli forces. Israel responded with police and military actions in Palestinian areas.

After the intifada began, Barak faced pressure to hold new elections. In 2001, Sharon defeated Barak in an election for prime minister. The intifada continued. Palestinian militias and suicide bombers killed hundreds of Israelis. Israel repeatedly invaded the West Bank and Gaza Strip, killing over 1,700 Palestinians. In 2002, Israel reoccupied much of the West Bank. Bernard Reich

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Begin, Menachem
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Meir, Golda
Netanyahu, Benjamin
Peres, Shimon
Perlman, Itzhak
Rabin, Yitzhak
Shamir, Yitzhak
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Judaism
Kibbutz
Masada
Palestine
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Western Wall
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VII. History

Questions

What percentage of Israel's people live in urban areas?
What is the difference between a *kibbutz* and a *moshav?*
Who was Israel's first prime minister?
What is the longest river in Israel?
Which of Israel's land regions has the largest population?
What are the three types of schools in Israel?
What is Israel's parliament called?
What percentage of Israel's people are Jews?
What was the Balfour Declaration?
What are the three largest cities in Israel?

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Israelites. See Jews; Palestine.

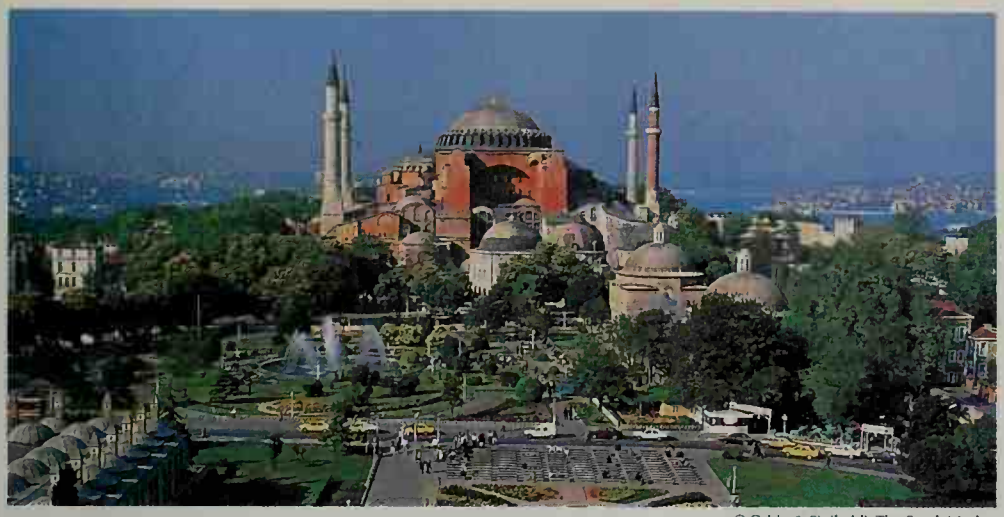
Istanbul, *IHS tan BOOL* (pop. 6,620,600), the largest city of Turkey, lies on two continents—Asia and Europe. Istanbul lies at the south end of the Bosporus, a strait in northwestern Turkey that connects the Black Sea and the Sea of Marmara. For location, see **Turkey** (political map). The Bosporus separates the Asian and European sections of Istanbul. The Bosporus Bridge and the Fatih Sultan Mehmet Bridge link the sections.

Istanbul has long been one of the world's most important cities. From A.D. 330 to 1453, Istanbul—then called Constantinople—served as the capital of the Roman and then of the Byzantine empires. It was the capital of the Ottoman Empire from 1453 to 1922. In 1923, with the birth of the Turkish republic, Ankara became the capital. But Istanbul remained Turkey's leading center of industry, trade, and culture. Tourists visit the city to see its bazaars, museums, palaces, Byzantine churches, and world-famous mosques.

The city. Istanbul covers 92 square miles (238 square kilometers). The European area is about $1\frac{1}{2}$ times as large as the Asian. About 75 percent of the people live on the European side. Asian Istanbul consists mainly of residential districts and port facilities.

European Istanbul is divided into old and modern sections by the Golden Horn, an inlet of the Bosporus. The old section lies south of the Golden Horn, and the modern section lies to the north. Beautiful mosques form the skyline of the old area. Narrow cobblestone lanes link government and commercial areas with parks, squares, and residential areas. The old section also includes a huge covered bazaar with more than 4,000 shops. The modern part is the main business area. Modern hotels and office buildings form its skyline.

Istanbul has 25 Byzantine churches, more than 1,000 mosques, and many museums. In the A.D. 530's, the Emperor Justinian I built the splendid Orthodox Christian



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Hagia Sophia is one of Istanbul's most famous landmarks. This masterpiece of Byzantine architecture was built in the A.D. 530's as a Christian cathedral. It was converted into a *mosque* (Islamic house of worship) in 1453. Its huge central dome measures 102 feet (31 meters) in diameter. Since 1935, Hagia Sophia has served as a museum.

cathedral called Hagia Sophia (also known as St. Sophia) in Istanbul. The church was converted into a mosque in 1453. Since 1935, it has been a museum. Istanbul's most famous mosques include the Süleymaniye Mosque and the Sultan Ahmet Mosque. Completed in 1557, the Süleymaniye Mosque was designed by the master architect Sinan. The Sultan Ahmet Mosque, often called the Blue Mosque because of the interior's blue tiles, is the only mosque in Istanbul with six *minarets* (Muslim prayer towers). Also in Istanbul is the Topkapi Palace, a museum that once was the home of Turkish sultans. Ruins of Byzantine aqueducts and ancient city walls still stand. Rumeli Hisar, a fortress built in 1452, overlooks the Bosporus, north of the city.

People. Most of the people of Istanbul are Muslim Turks. Minority groups include Jews, and Greek and Armenian Christians. Istanbul's population grew sharply in the middle and late 1900's. In 1990, the city had about 7 times as many people as it had in 1950, and about 9 times as many as it had in 1935. About half of the people who live there today were born in Istanbul. Most of the others come from towns and villages in Asian Turkey.

Istanbul's rapid population growth has caused many problems. Many new residents live in shacks on the outskirts of the city. Other people live in modern apartment buildings or in old, wooden buildings that stand crowded together on the hillsides.

Education and cultural life. Istanbul has been the cultural center of Turkey for hundreds of years. Istanbul University ranks as the oldest and largest Turkish university. Other universities and colleges include Marmara University, Istanbul Technical University, Bosporus University, and Koç University.

About 15 major libraries are in Istanbul. Turkey's largest book and newspaper publishers have their offices there. Istanbul's numerous theaters present plays, operas, and symphony concerts. Artists exhibit their work at the city's art galleries. Istanbul has more than 30 learned societies and research institutes.

Istanbul's churches and mosques are among the world's finest examples of Byzantine and Islamic architecture. The Museum of Turkish and Islamic Art displays such items as antique carpets, decorated manuscripts, and finely colored tiles. Visitors to the Topkapi Palace can see rooms used by Turkish sultans and their courts.

Economy. Istanbul is Turkey's major manufacturing center. Factories in the city produce cement, drugs, electrical appliances, glassware, leather goods, machinery, plastics, textiles, and processed foods. The city also has plants that assemble automobiles and trucks. Dockyards along the Bosporus build and repair ships.

Istanbul's location makes it a major center of trade and transportation. The city is Turkey's chief port. A major truck route between Europe and Asia passes through the city. Railroads link Istanbul with other parts of Europe and Asia. Yeşilköy Airport, about 15 miles (24 kilometers) west of the center of the city, has domestic and international flights.

Within Istanbul, most people travel on buses, on light rail vehicles, on ferryboats, or in special taxis called *dolmuş*. *The dolmuş* operate much as buses do. They travel along regular routes and carry several passengers at once.

History. People probably lived in what is now Asian Istanbul as early as 3000 B.C. During the mid-600's B.C., Greek colonists founded a city called Byzantium on the European shore. The city later became part of the Roman Empire. In A.D. 324, the Roman emperor Constantine I chose Byzantium as his capital. The city officially became the capital in A.D. 330. It was called *Constantinople*—city of Constantine.

In A.D. 395, the Roman Empire split into two parts. Barbarians conquered the West Roman Empire in the mid-400's. Constantinople remained the capital of the East Roman Empire (also called the Byzantine Empire). In A.D. 532, during the reign of Justinian I, antigovernment riots destroyed much of the city. Justinian rebuilt it with such fine structures as Hagia Sophia.

For the next several hundred years, Persians, Arabs, and nomadic peoples attacked Constantinople. In 1204, members of the Fourth Crusade conquered the city and damaged much of it. Crusader kings governed the city until 1261, when Byzantine rulers recaptured it.

The Ottoman Empire conquered Constantinople in 1453, and the city became the capital of the Ottoman Empire. The Ottomans called the city Istanbul. They launched military campaigns in Europe and the Middle East from the city. By the mid-1500's, Istanbul had become a major political, commercial, and cultural center with a population of almost half a million.

The Ottoman Empire began to weaken by the late 1600's. During the 1800's, the sultans introduced various

reforms in an attempt to strengthen and modernize the Ottoman Empire. European-style schools and other elements that were part of Western culture were brought into Istanbul.

During World War I (1914-1918), the Allies defeated the Ottoman Empire. They occupied Istanbul from 1918 to 1923. In 1922, Turkish nationalist forces under Mustafa Kemal (later called Kemal Atatürk) gained control of the government of the Ottoman Empire and abolished the office of sultan. In 1923, Kemal made Turkey a republic and moved the capital to Ankara.

During the middle and late 1900's, Istanbul's population grew rapidly. In the 1980's, the city tore down factories and slums along the Golden Horn and built new parks and playgrounds. In August 1999, a powerful earthquake struck northwestern Turkey, including Istanbul. It killed more than 17,000 people. F. Muge Gocek

Related articles in *World Book* include:

Architecture (Byzantine architecture; picture)
Bosporus
Byzantine Empire
Constantine the Great
Crusades
Hagia Sophia
Hippodrome
Turkey (History; picture)

Isthmian Games, *IHS mee uhn,* were ancient Greek competitions that formed part of a religious festival for Poseidon, god of the sea. The Isthmian Games were one of four international festivals. The others were the Nemean, Olympic, and Pythian games. During these festivals, Greeks from often hostile city-states could meet and compete in a peaceful setting.

The Isthmian Games were founded in 581 B.C. They were held every other year on the Isthmus of Corinth, which joins the Peloponnesus with the mainland. The competitions included boat, chariot, and foot races as well as boxing and wrestling. The athletic contests had separate divisions for boys, young men, and adult males. Lyre and flute players also had contests. All winners received palm boughs and crowns of celery leaves as prizes. Jon D. Mikalson

See also **Olympic Games** (The ancient games).

Isthmus, *IHS muhs,* is a narrow strip of land that connects larger bodies of land. Some isthmuses connect two continents. The Isthmus of Panama links North America and South America. Others join a continent to a peninsula. The Isthmus of Kra lies between Thailand, in Asia, and the Malay Peninsula.

WORLD BOOK map

Isthmus of Panama

Because an isthmus is narrow, it is a logical place to dig a canal between the two bodies of water it separates. Such canals shorten shipping routes. The Suez Canal, which cuts the isthmus between Africa and Asia, cut the distance between England and India by about 6,000 miles (9,700 kilometers). The Panama Canal through the Isthmus of Panama has made unnecessary the hazardous trip around the tip of South America. This canal saves 7,873 miles (12,670 kilometers) of water travel between New York and San Francisco.

Grenville Draper

See also **Panama Canal; Suez Canal.**

WORLD BOOK photo by E. F. Hoppe

The slender Italian greyhound has a graceful shape.

Italian greyhound is a breed of dog similar to the greyhound but much smaller. Most Italian greyhounds stand 13 to 15 inches (33 to 38 centimeters) high at the shoulder. The dog has a long, narrow head and a slender body, pinched in at the waist. Its short, glossy coat may be white, bluish-gray, black, or *fawn* (yellowish-brown). The dog lifts its front feet high when walking. Ancient Romans often kept Italian greyhounds. They hung up signs in their homes saying *cave canem* (watch out for the dog). These signs were to protect the tiny greyhounds from being stepped on accidentally.

Critically reviewed by the Italian Greyhound Club of America

Italian language is the official language of Italy and one of the official languages of Switzerland. It is also spoken by many people in areas of France and Slovenia that lie near Italy. More than 60 million people speak Italian as their native language. Italian, like English, belongs to the Indo-European family of languages. Like French and Spanish, it is a Romance language, one of the modern languages that developed from Latin.

Many words in other languages come from Italian. For example, English borrowed the words *balcony, carnival, cash, costume, laundry, malaria, opera, piano, pilot, stucco, studio, umbrella,* and *volcano.* Many other English words, such as *bankrupt, gazette,* and *infantry,* came from French, but their roots were Italian.

Italian grammar

Characteristics. The sounds of Italian are more simply organized than the sounds of English. Italian has 7 vowel and 20 consonant sounds. In addition, Italian spelling is more consistent than English spelling because each letter or combination of letters usually stands for only one distinct sound. As a result, a word is generally pronounced exactly as it is spelled. Each syllable in an Italian word is pronounced clearly and separately. The syllables are spaced evenly, and intonations extend over a wide range of pitch. These features give Italian speech a *staccato* (short, choppy) effect. Most syllables end with a vowel, as do most words, except for a few prepositions.

Italian and English have similar systems of grammar. In both, the nouns, pronouns, adjectives, and verbs have

inflections, which are changes of form. But the Italian system of inflection is more complicated than the English system. The essential part of an Italian sentence is the verb. In English, it is the combination of subject and verb.

Nouns and adjectives. Italian nouns are either masculine or feminine. For example, *the book (il libro)* is masculine, and *the necktie (la cravatta)* is feminine. Most plurals are formed by changing the final vowel. Nouns ending with an accented vowel, such as *città* (city), have only one form for the singular and plural.

Adjectives must agree with nouns in gender as well as *number* (singular or plural). Thus, the adjective *rosso* (red) has four forms: *il libro rosso* (the red book), *la cravatta rossa* (the red necktie), *i libri rossi* (the red books), and *le cravatte rosse* (the red neckties).

As in English, Italian personal pronouns have special forms to show their function in a sentence. The inflectional ending of the verb indicates the person and the number of the subject. In most sentences, a subject pronoun is not needed. But subject pronouns, such as *io* (I) and *noi* (we), are sometimes used for emphasis or clarity. An example is *Lo faccio io* (I'll do it).

Verbs in Italian are grouped according to the endings of their infinitives. They fall into three classes: *-are* verbs, such as *cantare* (to sing); *-ire* verbs, such as *dormire* (to sleep); and *-ere* verbs, such as *véndere* (to sell). Italian also has many irregular verbs.

Italian has seven verb moods. Each mood has a simple and a compound tense (see **Tense**). The *simple tenses* are formed by adding endings to the root. For example, *cantiamo* (we sing) is the present tense of *cantare.*

The *compound tenses* combine the past participle of a main verb with an appropriate form of the auxiliary verb *avere* (to have) or *essere* (to be). *Ha cantato* (he has sung) uses the present tense of *avere* to form the present perfect tense.

Word order in Italian sentences is less firmly fixed than it is in English, especially in the position of the subject and verb. The emphasis in a typical Italian sentence tends to fall at the end. For example, the sentence *My father did it* can be *Mio padre l'ha fatto,* to emphasize the action, or it can be *L'ha fatto mio padre,* to emphasize the person. A written Italian sentence can be made interrogative merely by adding a question mark at the end. No change in word order is necessary, as it usually is in English. In speaking Italian, questions not introduced by an interrogative, such as *what* or *why,* are indicated by a sharply rising intonation.

Pronouns and predicate complements combine with the verb to form a *verbal core.* The verbal core always follows a strict word order, with the pronoun usually preceding the verb. Some examples of the use of a verbal core are: *mi vedi* (you see me), *me lo dà* (he gives it to me), and *me ne dà* (he gives some to me).

Development

Italian developed gradually from the *vernacular Latin,* which was the form of Latin used in everyday speech (see **Latin language** [Development]). Italian emerged as a separate language about A.D. 1000. It consisted of several local dialects. In the early 1200's, the Sicilian dialect of the south became the chief literary language. At this time, Sicily was a great center of European cultural life. The court of the Holy Roman Emperor Frederick II in Sicily attracted artists and writers from all parts of Europe. After about 1250, Tuscany became the center of cultural life in Italy. The Tuscan dialect of Florence and the surrounding region then became the language of literature and culture.

The Tuscan dialect forms the basis of modern Italian. It was used by such great writers as Dante Alighieri, Petrarch, and Giovanni Boccaccio. From the 1300's to the 1500's, Italian was widely used as the language of commerce in the eastern Mediterranean area. By the middle 1500's, Italian had almost completely replaced Latin as a written and spoken language.

Many Italian dialects are still spoken. They include Emilian, Ligurian, Lombard, Piedmontese, and Venetian in northern Italy; Corsican, Roman, Tuscan, and Umbrian in central Italy; and Abruzzese, Apulian, Calabrian, Neapolitan, and Sicilian in the south. These dialects are gradually being replaced by standard Italian, which is used throughout Italy. However, a large number of Italians speak dialects with their families and in their communities.

Modern Italian has lost much of its Tuscan character and has borrowed words from many Italian dialects. Many influences in Italy have helped standardize Italian. They include military service, education, and nationwide communication by means of newspapers, books, radio, and television. Paolo Cherchi

See also **Romance languages.**

Common words and expressions

arrivederci, *ahr REE veh DAYR chee,* good-bye
bene, *BEH nay,* well
buon giorno, *BWAWN JOHR noh,* good morning, good day, hello
buona sera, *BWAW nah SAY rah,* good afternoon, good evening
buono, *BWAW noh,* good
cattivo, *kaht TEE voh,* bad
come sta?, *KOH may STAH,* how are you?
gli spaghetti, *lyee spah GEHT tee,* the spaghetti
grazie, *GRAH tsyay,* thank you
il bambino, *eel bahm BEE noh,* the child
il caffè, *eel kahf FAY,* the coffee
il gelato, *eel jeh LAH toh,* the ice cream
il minestrone, *eel MEE nehs TROH nay,* the soup
il ristorante, *eel REE stoh RAHN tay,* the restaurant
il vestito, *eel vehs TEE toh,* the dress
l'àbito, *LAH bee toh,* the suit
l'albergo, *lahl BAIR goh,* the hotel
l'antipasto, *lahn tee PAHS toh,* the hors d'oeuvres
la blusa, *lah BLOO sah,* the blouse
la camicia, *lah kah MEE chah,* the shirt
la carne, *lah KAHR nay,* the meat
la casa, *lah KAH sah,* the house
la gonna, *lah GAWN nah,* the skirt
la sedia, *lah SEH dyah,* the chair
la tavola, *lah TAH voh lah,* the table
la verdura, *lah vair DOO rah,* the vegetables
no, *noh,* no
non capisco, *nohn kah PEE skoh,* I don't understand
per favore, *payr fah VOH ray,* please
scusa, *SKOO sah,* I beg your pardon
sì, *see,* yes
signor, *see NYOHR,* Mr.
signora, *see NYOH rah,* madam, Mrs.
signore, *see NYOH reh,* sir
signorina, *see nyoh REE nah,* Miss

Italian literature includes many masterpieces written since the early 1200's. It has also promoted important cultural movements that have had lasting impact on other national literatures. Italian did not become a common national language until after 1870. However, a distinctive characteristic of Italian literature is the uniformity of its language throughout its long history. This uniformity occurred because three great Italian writers of the 1300's—Dante Alighieri, Petrarch, and Giovanni Boccaccio—wrote in a language based on the Tuscan dialect spoken in Florence. Their language and their works were imitated for many centuries, even while Italians used many spoken dialects.

The Middle Ages

Some scholars believe that Italian literature originated in 1225, when Saint Francis of Assisi wrote "Canticle of the Sun." This poem was the first important literary composition to be written in the *vernacular*—that is, the language used in everyday speech—instead of in Latin. "Canticle" was also a work that expressed the religious feeling of the masses. Therefore, it is considered the first "Italian voice" in literature.

Another Italian voice originated in Sicily. At the court of Emperor Frederick II, who ruled at Palermo during the first half of the 1200's, many intellectuals and poets gathered. These poets became known as the *Sicilian School,* and wrote in a refined Sicilian dialect. Their poems imitated the love poems of the early troubadours. These poets also created new forms of poetry, such as the sonnet.

The Sicilian School broke up with the death of Frederick II's son Manfred in 1266 and the decline of political power in Sicily. But it became a model for other poets, especially in Tuscany. There, Guittone d' Arezzo won acclaim for the realistic yet obscure language of his love poetry. His artistic leadership was opposed by the poet Guido Guinizelli of Bologna. Guinizelli is considered the founder of the *Dolce stil nuovo* (sweet new style), a school that added a philosophical dimension to traditional love poetry. Poets in this school viewed women as angelic creatures and love as the source of virtue. This new understanding of love, expressed in a smooth, pure style, influenced some Florentine poets, especially Guido Cavalcanti and the young Dante Alighieri. Dante's *The Divine Comedy* (1321), one of the greatest poetic achievements of all time, helped create the Italian literary language.

Humanism and the Renaissance

New ideas and attitudes in Italian literature were promoted by Petrarch in the mid-1300's. He helped found *humanism,* a movement to revive classical cultures and to emphasize the importance of the individual person (see **Humanism**). Petrarch wrote most of his works in Latin. But in *Canzoniere (Book of Songs),* a collection of poems in Italian, Petrarch wrote of his love for a woman called Laura in a language so beautiful that it served as a model for many centuries.

Petrarch's close friend Giovanni Boccaccio also wrote some works in Latin. However, he wrote his masterpiece, the *Decameron* (about 1349-1353), in Italian. This collection of 100 short stories depicts characters and scenes of his day with great realism and humor.

Humanistic literature in Latin overshadowed literature in Italian until the second half of the 1400's. The revival of literature in the vernacular centered in Florence. There, a brilliant group of writers gathered at the court of poet and statesman Lorenzo de' Medici. These writers included Angelo Poliziano, whose *Stanzas for the Joust* blended the classical and vernacular traditions. Humorist Luigi Pulci ridiculed the heroic poems of his time in his mock epic *Il Morgante Maggiore* (1478, 1483).

Important literary activity also took place in other parts of Italy. Matteo Maria Boiardo, serving at the northern court of Ferrara, wrote the unfinished chivalry poem *Orlando innamorato* (1487). In Naples, Jacopo Sannazaro wrote *Arcadia* (1501-1504). This work combined *pastoral* and prose poetry and influenced many European authors (see **Poetry** [Renaissance poetry]).

Although humanism continued in the early 1500's, literature in the vernacular became increasingly important. Niccolò Machiavelli's *The Prince* (written in 1513 and published in 1532) is one of the world's most famous essays on political science. Another important work of the period, Ludovico Ariosto's *Orlando furioso* (1516, revised in 1521 and 1532), is perhaps the greatest chivalry poem ever written. It continues the plot of Boiardo's *Orlando innamorato,* but is full of ironic overtones. Baldassare Castiglione's dialogue *The Book of the Courtier* (completed about 1518 and published in 1528) describes the ideal of the perfect court gentleman and of spiritual beauty.

During the early 1500's, Italian writers began to base their language on the language of Petrarch and Boccaccio. This development occurred largely because of the theoretical and creative works of Pietro Bembo. Petrarch's poetry served as the model for many lyrics about spiritual love.

By the mid-1500's, a renewal movement in the Roman Catholic Church known as the Counter Reformation generated changes in the arts (see **Counter Reformation**). The Renaissance ideal of harmony was replaced by exaggerated attention to formal features, producing a style known as *mannerism.* The reintroduction in Italy of the *Poetics* by the ancient Greek philosopher Aristotle kindled a debate over the nature of literature. The debate provided the basis for modern literary criticism, with its idea of art imitating reality. History, Christian values, and the supernatural influenced Torquato Tasso's epic *Jerusalem Delivered* (completed in 1575 and published in 1581). Italian drama also developed during the 1500's, notably *commedia dell'arte*—a comedy based on improvisation.

The baroque period and the Age of Reason

By the 1600's, the religious and political situations in Italy had helped cause a decline in the quality of literature. France and Spain sought control of Italy, and the crisis became evident in the baroque period of the 1600's, during which Italy lost its cultural leadership of Europe. Some literary masterpieces were created, such as Giambattista Marino's long mythological poem, *Adonis* (1623). The baroque period also produced the clear scientific prose of Galileo as well as Tommaso Campanella's *The City of the Sun* (1623), a description of a perfect society ruled by a philosopher-priest.

During a period called the Age of Reason in the

1700's, a literary awakening took place. In poetry, a plainer, less elaborate style known as Arcadia battled with the more complex baroque style. Pietro Metastasio adapted classical themes to suit current taste in the *librettos* (words) he wrote for operas. Carlo Goldoni replaced commedia dell'arte with fully written plays. In many works, such as *The Mistress of the Inn* (1753), he depicted the middle class. Vittorio Alfieri restored classical tragedy in *Saul* (1782) and other works. Cesare Beccaria wrote *On Crimes and Punishments* (1764), which spoke out strongly against torture and the death penalty. Giuseppe Parini's unfinished poem *The Day* (1763-1765) satirized the empty days of a nobleman.

In the late 1700's, a desire for balance between reason and tradition led to the development of *Neoclassicism.* The major Neoclassical writer was Ugo Foscolo.

Romanticism

Romanticism was a movement that elevated sentiment over reason, national history over mythology, and individualism over universalism. Italian writers embraced Romanticism in the early 1800's. The movement coincided with some ideas of the *Risorgimento,* the patriotic movement that brought Italy political unity and freedom from foreign domination. *The Betrothed* (1827, 1840-1842) by Alessandro Manzoni, the leading Italian Romantic, was the first Italian historical novel to glorify Christian values of justice and God's help. Manzoni's tragedies *The Count of Carmagnola* (1820) and *Adelchi* (1822) were the first plays to break away from classical principles. One of the era's foremost poets, Giacomo Leopardi, wrote *Songs* (1836). These poems express a deeply pessimistic view of human nature.

The unification of Italy in 1870 brought social unrest and political turmoil to the nation. Literary responses to the situation either recalled Italy's past glories or tried to make the new Italy understandable. The first response came from the poet Giosuè Carducci. He showed disdain for the sentimentality of Romanticism. Instead, he favored a classical glorification of patriotic values. The second response came as a realistic movement in fiction known in Italy as *verismo.* The members of this movement described as objectively as possible the life and the passion of the poor and the displaced. Giovanni Verga, the most distinguished verismo writer, portrayed Sicilian peasants and fishermen in *The House by the Medlar Tree* (1881). Gabriele D'Annunzio followed Carducci in celebrating historical values. Giovanni Pascoli wrote poetry with mystic overtones that influenced much later poetry.

The 1900's

A movement called *Futurism* influenced Italian literature in the early 1900's. Filippo Tommaso Marinetti wrote *The Manifesto of Futurism* (1909). It called for the use of language and metaphors that glorified the speed, dynamism, and violence of the machine age. Luigi Pirandello wrote novels and plays that focused on such themes as problems of personal identity and the absurdity of reality. These themes are also found in the fiction of Italo Svevo. The same themes, along with philosophical pessimism, appear in the works of poets Eugenio Montale, the major Italian poet of the 1900's; Salvatore Quasimodo; and Giuseppe Ungaretti.

For about 20 years after World War II ended in 1945, Italian writers tried to reconstruct the country's literature in a realistic style that became known as *Neorealism.* The novelist Alberto Moravia was the leader of the postwar authors. This group of writers included fiction writers Cesare Pavese, Vasco Pratolini, and Elio Vittorini.

Later, much experimentation took place among Italian writers. These experimental authors include novelist Emilio Gadda and poet Pier Paolo Pasolini. Other important authors of the late 1900's include novelist Italo Calvino and playwright Dario Fo, who won the 1997 Nobel Prize for literature. Paolo Cherchi

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D'Annunzio, Gabriele
Dante Alighieri
Foscolo, Ugo
Francis of Assisi, Saint
Goldoni, Carlo
Leopardi, Giacomo
Machiavelli, Niccolò
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Italics *is the style of type in which this sentence is printed.* In typed or handwritten copy, italics are indicated by single underlining. A Venetian printer, Aldus Manutius (1450?-1515), first used italic type. He based it on a style of handwriting of his time. At present, italic type is commonly used for titles of books, newspapers, magazines, and motion pictures. Words are often set in italics when used to mark a word without regard for its meaning, as in "*Bee* is a noun," and for special emphasis, as in "But he *was* here!" Italics also indicate foreign words.

J. C. McCracken

Italo-Ethiopian War, *ih TAL oh ee thee OH pee uhn,* was fought between Italy and the African Empire of Ethiopia (formerly Abyssinia) from 1935 to 1936. Benito Mussolini, Italy's ruler, started the war in order to turn the attention of Italians away from problems at home. He also hoped to gain a source of raw materials for Italian industry.

The invasion of Ethiopia began in October 1935, and the Italians soon captured many Ethiopian towns. Italian bombs made ruins of the flimsily built towns. Emperor Haile Selassie felt that it was hopeless to continue to wage war against an enemy equipped with such modern weapons, and fled from the country. On May 5, 1936, the Italians under Marshal Pietro Badoglio took control of Addis Ababa, which was Ethiopia's capital. Mussolini proclaimed Ethiopia Italian territory, with the king of Italy as emperor. Haile Selassie did not return to his throne until 1941.

Italy had acted against the principles of the League of Nations. The League tried to stop the war by cutting off much of Italy's trade. But the League's efforts were ineffective. Peter P. Garretson

See also League of Nations.

© Earl Roberge, Photo Researchers

Italy's majestic countryside includes such winter resorts as Cortina d'Ampezzo in the Alps. The Alpine ski slopes—together with the country's sunny seaside resorts, historic cities, and world famous art and architecture—have made Italy a leading tourist nation.

Italy

Italy is a country in southern Europe. It is known for its rich cultural heritage and natural beauty. Its cities have spectacular churches and large central plazas. Their museums contain some of the world's best-known art. The countryside has warm, sandy beaches; high, glacier-topped mountain peaks; and rolling hills covered with green fields and vineyards.

Italy occupies a boot-shaped peninsula that extends into the Mediterranean Sea from southern Europe. The country also includes two large islands, Sicily and Sardinia. Two independent countries lie within Italy's borders: the tiny Republic of San Marino, in north-central Italy, and Vatican City, which is located completely within the city of Rome.

Italy's landscape is dominated by two mountain ranges—the Alps and the Apennines. The Alps tower across the northernmost part of Italy. The Apennines form a backbone that runs nearly the entire length of the peninsula.

Italy got its name from the ancient Romans. The Romans called the southern part of the peninsula *Italia,* meaning *land of oxen* or *grazing land.*

The country boasts several world-famous cities. Rome, the capital and largest city of Italy, was the center of the Roman Empire 2,000 years ago. Florence was the home of many artists of the Renaissance, a period of great achievements in the arts. Venice, with its intricate canal system, attracts tourists from all over the world.

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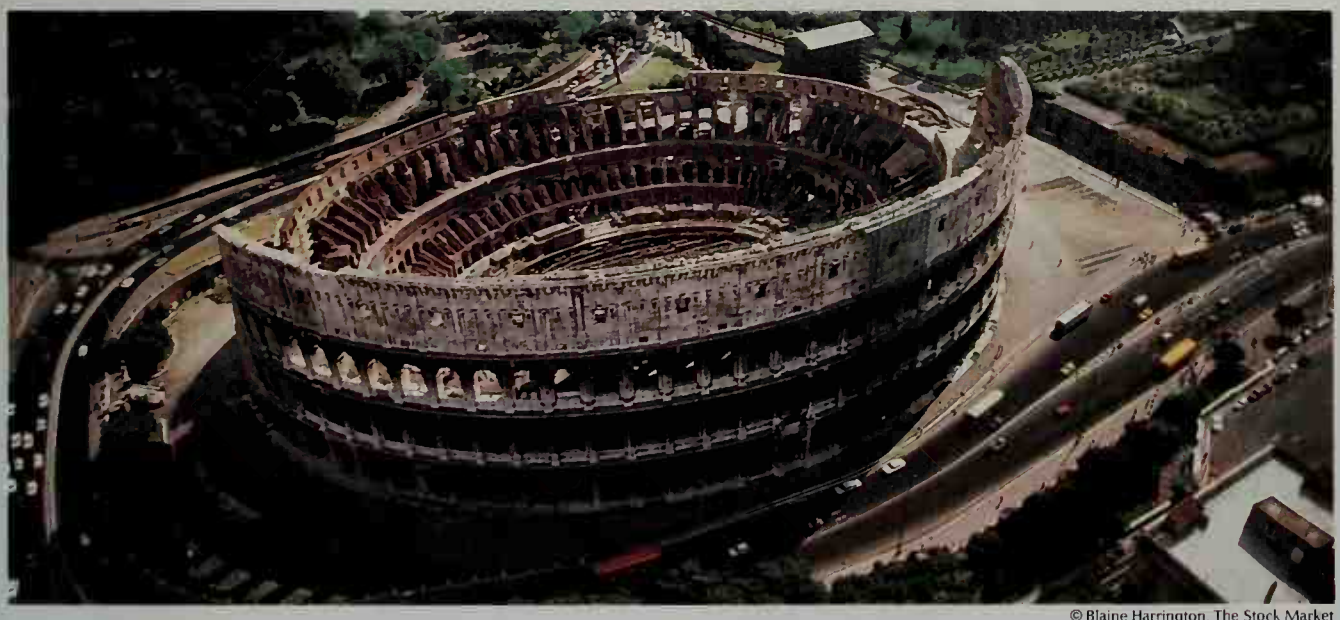
Outdoor restaurants, such as this one in Rome, are a common sight in Italian cities. People gather at such restaurants to enjoy good food in a pleasant urban setting.

E. Streichan, Shostal

The village of Positano lies on the Tyrrhenian Sea near Amalfi. Picturesque white houses are nestled on the rocky cliffs of this popular resort town.



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The Colosseum, in downtown Rome, is one of the most famous surviving architectural marvels of the Roman Empire. It is a reminder of the long and rich history of the Italian peninsula.

For hundreds of years, the history of Italy dominated the history of Western civilization. Ancient Rome began its overseas conquests during the 200's B.C., and by the A.D. 100's the Roman Empire controlled all the lands bordering the Mediterranean Sea. The empire influenced the government, the arts, and the architecture of many later groups of people. After the fall of Rome in the A.D. 400's, the Italian peninsula was divided among many different rulers.

Much of the Italian peninsula was united during the early 1800's, when Napoleon Bonaparte captured the region and made it part of the French Empire. Most of Italy was united as an independent country for the first time in 1861 under the constitutional monarchy headed by King Victor Emmanuel II.

Benito Mussolini, a Fascist, took control of the Italian government in the early 1920's (see **Fascism**). Mussolini ruled as a dictator until 1943, when he was overthrown as a result of Italy's declining fortunes in World War II (1939-1945). In 1946, the people of Italy voted to abolish the monarchy. Italy has had a republican form of government since that time.

Since World War II, Italy has experienced great economic and industrial expansion. Today, northern Italy is among Europe's wealthiest and most modern regions, but the south of Italy remains considerably poorer.

Government

Italy set up its present form of government in 1946. That year, the people voted to change their nation from a monarchy ruled by a king to a republic headed by a president. King Umberto II (also spelled Humbert)

Italy in brief

General information

Capital: Rome.
Official language: Italian.
Official name: *Repubblica Italiana* (Italian Republic).
National anthem: "Fratelli d'Italia" ("Brothers of Italy").
Largest cities: (1991 census)

Rome (2,775,250)	Naples (1,067,365)
Milan (1,369,231)	Turin (962,507)

The Italian flag, adopted in 1870, was first used in 1796 by Italians who supported Napoleon Bonaparte of France in a war against Austria. Napoleon designed the flag to look like that of France, but substituted green, his favorite color, for the blue of the French flag.

Italy's coat of arms was established after the formation of the Italian republic in 1946. The star represents unity, the wreath of laurel and oak stands for republicanism, and the cogwheel represents industry. The country's name in Italian is on the ribbon.

Land and climate

Land: Italy lies in southern Europe on the Mediterranean Sea. It borders France, Switzerland, Austria, and Slovenia. The Alps form Italy's northern and northwestern border. The Apennines (a mountain chain) occupy the center of Italy's peninsula. The Po River Valley is Italy's only major flat area.

Area: 116,320 mi² (301,268 km²). *Greatest distances*—north-south, 708 mi (1,139 km); east-west, 320 mi (515 km).
Elevation: *Highest*—near the summit of Mont Blanc, which is 15,771 ft (4,807 m). *Lowest*—sea level.
Climate: Central and southern Italy have hot summers—daytime high temperatures of about 86 °F (30 °C). Winters are mild, with daytime highs reaching about 54 °F (12 °C). Northern Italy is only slightly cooler than the rest of the country in summer. However, it is much cooler in winter—daytime highs of only about 41 °F (5 °C). The north receives adequate year-round moisture. Central and southern Italy have dry summers and moderate winter rainfall. In general, total precipitation decreases from north to south.

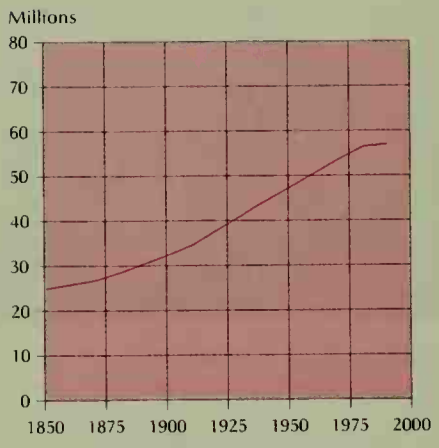
Government

Form of government: Parliamentary democracy.
Head of state: President (elected by Parliament to a 7-year term).
Head of government: Prime minister.
Legislature: Parliament of two houses—the Chamber of Deputies (630 members) and the Senate (315 elected members). The two houses have equal legislative powers.
Executive: Prime minister, nation's chief executive, is approved by Parliament. Prime minister chooses Cabinet.
Judiciary: Highest court is the Constitutional Court.
Political subdivisions: 20 regions, each divided into provinces and communes.

People

Population: *2002 estimate*—57,092,000. 1991 census—59,103,833.
Population density: 491 per mi² (190 per km²).
Distribution: 97 percent urban, 3 percent rural.
Major ethnic/national groups: About 98 percent Italian; small numbers of Germans, French, and Slovenes.
Major religion: Roman Catholic (95 percent of population).

Population trend



Year	Population
1851	25,017,000
1871	26,801,000
1881	28,460,000
1901	32,475,000
1911	34,671,000
1921	37,974,000
1931	41,177,000
1936	42,919,000
1951	47,516,000
1961	50,624,000
1971	53,745,000
1981	56,557,000
1991	59,104,000

Economy

Chief products: *Agriculture*—grapes, wheat, beef cattle, hogs, olives, corn, oranges, tomatoes. *Manufacturing*—clothing and shoes, foods and beverages, motor vehicles, petroleum products, machinery, chemicals. *Mining*—natural gas, granite, marble.
Money: *Basic unit*—euro. One hundred cents equal one euro. The lira, the former basic unit, was taken out of circulation in 2002.
Foreign trade: *Major exports*—clothing and shoes, motor vehicles, machinery, chemicals, fruits and vegetables. *Major imports*—machinery, petroleum, motor vehicles, textile yarns, metals. *Major trading partners*—Germany, France, United States, United Kingdom, Netherlands.

immediately left the throne. The voters elected a group of 556 members, called a Constituent Assembly, to write a constitution. The constitution was approved in 1947 and became effective on Jan. 1, 1948. The constitution established a governing system made up of a president, a cabinet called the Council of Ministers headed by a prime minister, and a Parliament made up of a Senate and a Chamber of Deputies.

President. The president of Italy is elected to a seven-year term by both houses of Parliament. The president must be at least 50 years old. He or she appoints the prime minister, who forms a government. The president has the power to dissolve Parliament and call new elections. The president is the commander of the Italian armed forces, and can declare war.

Italy has no vice president. If the president becomes ill, the president of the Italian Senate takes over the office. If the president dies, a presidential election is held.

Prime minister and cabinet. The prime minister determines national policy and is the most important person in the Italian government. The prime minister is selected by the president—usually from the members of Parliament—and must be approved by Parliament. The prime minister has no fixed term of office and can be voted out of office by Parliament at any time.

Members of the Cabinet are chosen by the prime minister, and they are usually selected from the members of Parliament. They are then appointed by the president and must be approved by Parliament. The Italian prime minister and the cabinet are officially called the *government.*

Parliament consists of a Chamber of Deputies and a Senate. These two houses have equal power in passing laws. The Chamber of Deputies has 630 members. The Senate has 315 elected members, and 5 appointed for life by the president. All former presidents also become senators for life. Deputies are chosen by the voters from 27 *constituencies* (voter districts). The elected senators are chosen from 20 units of local government called regions. Deputies and senators serve five-year terms. But the president may dissolve Parliament and call for new elections before the term is up.

Italy's voters directly elect three-fourths of the members of both the Chamber of Deputies and the Senate. The other one-fourth of both houses are elected by a complicated system based on *proportional representation.* In this system, the percentage of the remaining seats held by each political party is about the same as the percentage of total votes received by the party's candidates. However, only parties that win at least 4 percent of the total votes will receive seats in Parliament.

A large number of political parties are represented in Italy's Parliament. Political parties form *coalitions* (partnerships) in order to have enough power to gain control of the government.

National politics. Since 1948, Italy has had frequent cabinet changes. Most cabinets have lasted less than a year. But many members of one cabinet remain in the next one, thus providing continuity. In coalition governments, cabinet members are from different political parties. If some of the parties in the cabinet disagree with its policies, they may withdraw their support and require the formation of a new cabinet.

Italy has a number of important political parties. The leading parties include Forza Italia, the Christian-Democratic Center, the Democrats of the Left, the Green Party, the Italian People's Party, the Italian Social Democratic Party, the National Alliance, the Republican Party, and the United Christian Democrats.

Local government. Italy has a *unitary system* of government. In Italy, this means that the national government possesses most of the power.

The country is divided into large governmental units called *regions.* Each region is further divided into *provinces,* and each province consists of a number of *communes.* Each of the country's regions, provinces, and communes has an elected one-chamber council called a *consiglio* in addition to an executive body called a *giunta.*

The 1948 Constitution provided for a system of regional governments that was not completed until the 1970's. Today, there are 20 regional governments in the country. Each region is governed by a democratically elected president who serves a four-year term. Council members are elected by the people. Italy's Parliament has granted broad administrative and legislative powers to the regional governments.

Each of Italy's provinces takes its name from its principal city, and is governed by the elected council and by an official called a *prefect.* The people elect each prefect to a term of four years.

The communes are Italy's smallest units of local government. Each commune has a mayor elected by its citizens to a four-year term.

Courts. All judges of Italian courts are appointed, rather than elected. Except for the 15 judges of the Constitutional Court, Italian judges earn their appointments through civil service examinations. Five judges of the Constitutional Court are chosen by the president, five by Parliament, and five by judges of other courts. All courts operate under the national ministry of justice and a panel of judges called the Superior Council of the Judiciary. The Constitutional Court, the highest court in Italy, can declare acts of Parliament illegal.

Italy has a number of lower courts. Appeals from civil and criminal courts are brought before *courts of appeals.* Cases involving serious crimes are heard in *courts of assizes.* A court called the *court of cassation* reviews decisions of lower courts. This court can return cases to the lower courts for new trials.

Armed forces. For about 200 years, Italy filled the ranks of its armed forces by requiring military service from its young men. Beginning in 1999, though, women were allowed to volunteer for military service. Then in 2000, Italy decided to phase out the military draft by 2006. About 270,000 people serve in Italy's armed forces.

People

Population and ancestry. Most of Italy's people live in urban areas. Italy's largest cities, in order of population, are Rome, Milan, and Naples. Each has more than a million people. Many of the country's cities are surrounded by large metropolitan areas.

The most densely populated areas of the country are the industrialized regions of Lombardy and Liguria in the northwest and the region of Campania in the south. The areas with the lowest population density are the mountains of both the north and south.

Italy map index

Regions

Name	Population	Area In sq. mi.	Area In km²	Capital	Map keys
Abruzzi	1,249,054	4,168	10,794	L'Aquila	E 5
Apulia (Puglia)	4,031,885	7,470	19,347	Bari	F 6
Basilicata	610,528	3,858	9,992	Potenza	G 6
Calabria	2,070,203	5,822	15,080	Reggio di Calabria	H 6
Campania	5,630,280	5,249	13,595	Naples	F 5
Emilia (Emilia-Romagna)	3,909,512	8,542	22,123	Bologna	C 3
Friuli-Venezia Giulia	1,197,666	3,029	7,845	Udine	B 4
Latium (Lazio)	5,140,371	6,642	17,203	Rome	E 4
Liguria	1,676,282	2,090	5,413	Genoa	C 2
Lombardy (Lombardia)	8,856,074	9,205	23,842	Milan	B 2
Marches (Marche)	1,429,205	3,742	9,693	Ancona	D 4
Molise	330,900	1,713	4,438	Campobasso	F 5
Piedmont (Piemonte)	4,302,565	9,807	25,399	Turin	C 1
Sardinia (Sardegna)	1,648,248	9,301	24,090	Cagliari	G 2
Sicily (Sicilia)	4,966,386	9,926	25,708	Palermo	I 4
Trentino-Alto Adige	890,360	5,256	13,613	Trento	B 3
Tuscany (Toscana)	3,529,946	8,877	22,991	Florence	D 3
Umbria	811,831	3,529	8,456	Perugia	E 4
Valle D'Aosta	115,938	1,259	3,262	Aosta	B 1
Venetia (Veneto)	4,380,797	7,092	18,368	Venice	B 3

Cities and towns

Abano Terme* 17,735 B 3
Acerra* 41,311 F 5
Acireale 46,199 I 6
Acqui 20,357 C 2
Acri* 22,223 G 6
Adrano 32,717 I 5
Adria* 21,225 C 4
Afragola 60,065 F 5
Agrigento 55,283 I 4
Alassio 11,574 D 1
Alatri* 25,038 E 4
Alba 29,382 C 1
Albano Laziale* 31,399 E 4
Alberobello* 10,655 F 7
Alcamo 42,621 I 4
Alessandria 90,753 C 2
Alghero 39,026 F 1
Altamura 57,874 F 6
Amalfi 5,589 F 5
Ancona 101,285 D 4
Andria 90,063 F 6
Anzio 33,497 F 4
Aosta 36,214 B 1
Aprilia* 47,037 F 4
Arezzo 91,626 D 3
Argenta* 22,529 C 4
Arzano* 40,098 F 5
Ascoli Piceno 53,591 E 4
Assisi 24,626 D 4
Asti 73,557 C 1
Augusta 34,189 I 6
Avellino 55,662 F 5
Aversa* 54,032 F 5
Avezzano 37,179 E 4
Avola 31,322 I 6
Bagheria 47,085 H 4
Baia e Latina* 2,269 F 5
Barcellona Pozzo di Gotto 40,544 H 6
Bari 342,309 F 6
Barletta 89,527 F 6
Bassano del Grappa 38,871 B 3
Battipaglia 47,139 F 5
Belluno 35,572 B 4
Benevento 62,561 F 5
Bergamo 114,936 B 2
Biella 48,324 B 1
Bisceglie* 47,408 F 6
Bitonto 53,772 F 6
Bollate* 42,923 B 2
Bologna 404,378 C 3
Bolzano 98,928 B 3
Bordighera* 11,129 C 1
Bormio* 4,104 B 3
Bra 27,211 C 1
Brescia 194,502 B 3
Bressanone 16,992 A 3
Bresso* 30,119 B 2
Brindisi 95,383 F 7
Bronte* 18,689 I 5
Busto Arsizin 77,094 B 2
Caivano* 35,855 F 5
Cagliari 204,237 G 2
Caltagirone 36,898 I 5
Caltanissetta 61,319 I 5
Camaiore* 30,648 C 3
Campi Bisenzio* 34,444 D 3
Campobasso 50,941 F 5
Canicatti 32,344 I 5
Canosa di Puglia* 31,240 F 6
Cantù* 36,151 B 2
Capannori* 43,874 C 3
Capua* 18,845 F 5
Carbonia 32,887 H 1
Carpi 60,715 C 3
Carrara 67,197 D 3
Casale Monferrato* 38,962 B 2
Casalecchio di Reno* 34,503 C 3
Cascina* 36,301 D 3
Caserta 69,027 F 5
Casoria* 79,707 F 5
Cassino 32,787 F 5
Castel Gandolfo* 6,843 E 4
Castellammare di Stabia 68,733 F 5
Castelvetrano 30,272 I 4
Catania 333,075 I 6
Catanzaro 96,614 H 6
Cattolica* 15,115 D 4
Cava de' Tirreni* 52,502 F 5
Cefalù 13,882 H 5
Cerignola 55,052 F 6
Cesano Maderno* 31,934 B 2
Cesena 88,487 D 4
Cesenatico* 20,390 D 4
Chiavari 28,584 C 2
Chieri* 31,292 B 2
Chieti 55,876 E 5
Chioggia 53,179 C 4
Chivasso 24,758 C 1
Ciampino* 35,685 E 4
Cinisello Balsamo* 76,262 B 2
Città di Castello 37,455 D 4
Citta della* 18,061 B 3
Civitanova Marche 37,260 D 5
Civitavecchia 51,201 E 3
Collegno* 47,161 B 1
Cologno Mnnzese* 51,343 B 2
Como 87,059 B 2
Conegliano 35,656 B 4
Copparo* 19,273 C 3
Corato 42,750 F 6
Corigliano Calabro 35,615 G 6
Corsico* 37,385 B 2
Cortina d'Ampezzo 7,109 B 4
Cortona 22,598 D 4
Cosenza 86,664 G 6
Crema* 33,238 B 3
Cremona 74,113 C 2
Crotone 59,001 H 7
Cuneo 55,794 C 1
Desio* 34,085 B 2
Domodossola 18,865 B 2
Eboli 33,964 F 5
Empoli 43,522 D 3
Enna 28,273 I 5
Ercolano* 61,233 F 5
Erice* 29,420 H 4
Este* 17,668 B 4
Fabriano 28,721 D 4
Faenza 54,139 C 3
Fano 53,909 D 4
Fasano* 38,782 F 7
Favara* 32,237 I 5
Feltre* 19,785 B 4
Fermo 35,111 D 4
Ferrara 138,015 C 3
Fidenza* 23,192 C 3
Fiesole* 15,096 B 3
Florence (Firenze) 403,294 D 3
Foggia 156,268 F 6
Foligno 53,202 D 4
Fondi 31,169 F 4
Forli 109,541 C 4
Formia 34,957 F 5
Fossano* 23,436 C 1
Francavilla Fontana 33,995 F 7
Frascati* 20,123 E 4
Frattamaggiore* 36,089 F 5
Frosinone 45,815 F 4
Gaeta 22,334 F 4
Galatina 29,296 G 7
Gallarate* 44,977 B 2
Gallo Matese* 927 F 5
Gela 72,535 I 5
Genoa (Genova) 678,771 C 2
Giarre* 26,853 I 6
Giugliano in Campania* 60,096 F 5
Gorizia 38,505 B 4
Gravina di Puglia 39,261 F 6
Grosseto 71,257 E 3
Grottaglie* 30,947 F 7
Grugliasco* 41,115 B 1
Gubbio 30,792 D 4
Guidonia 57,473 E 4
Guspini 13,380 G 1
Iesi 40,156 D 4
Iglesias 30,134 G 1
Imola 62,567 C 3
Imperia 40,708 D 1
Insernia 20,933 F 5
Ivrea 24,704 B 1
Lanciano 34,006 E 5
L'Aquila 66,813 E 4
La Spezia 101,442 D 2
Latina 106,203 F 4
Lecce 100,884 G 7
Lecco 45,872 B 2
Legnago 26,271 C 3
Legnano* 50,018 B 2
Lentini 27,764 I 5
Licata 41,300 I 5
Limbiate* 31,873 B 2
Lissone* 32,177 B 2
Livorno 167,512 D 3
Lodi 42,250 C 2
Loreto* 10,780 D 4
Lucca 87,100 D 3
Lucera 35,615 F 5
Lugo* 32,204 C 3
Macerata 43,040 D 4
Maddaloni* 37,133 F 5
Magenta* 23,667 B 2
Manduria 31,453 F 7
Manfredonia 58,318 F 6
Mantova (Mantua) 53,065 C 3
Marano di Napoli* 47,961 F 5
Marcianise* 35,929 F 5
Marsala 80,177 I 4
Martina Franca 45,404 F 7
Massa 66,737 D 2
Massafra* 30,623 F 7
Matera 54,919 F 6
Mazara del Vallo 47,750 I 4
Melfi 15,757 F 6
Merann 33,504 A 3
Mesagne 30,267 F 7
Messina 231,693 H 6
Milan (Milano) 1,369,231 B 2
Milazzo 31,541 H 6
Mira* 36,432 B 4
Mirandola* 21,588 C 3
Misterbianco* 40,785 I 5
Modena 176,990 C 3
Modugno* 37,056 F 6
Modica 50,529 I 5
Molfetta 66,839 F 6
Moncalieri* 59,700 B 1
Mondovi* 22,155 C 1
Monfalcone 27,223 B 4
Monopoli 46,733 F 7
Monreale 26,256 H 4
Monte Sant' Angelo 15,082 E 6
Montecatini Terme* 20,653 D 3
Montepulciano* 13,856 D 4
Montesilvano* 35,153 E 5
Monza 120,651 B 2
Naples (Napoli) 1,067,365 F 5
Nardò 31,490 G 7
Narni* 20,439 E 4
Nettuno 33,827 F 4
Nicastro 70,114 H 6
Nichelino* 44,069 C 1
Nicosia 15,029 I 5
Niscemi* 26,998 I 5
Nocera Inferiore* 49,053 F 5
Nola* 32,613 F 5
Noto* 21,704 I 6
Novara 101,112 B 2
Novi Ligure 30,021 C 2
Nuoro 37,527 G 2
Olbia 41,095 F 2
Oristano 30,990 G 1
Ortona 22,601 E 5
Orvieto 21,419 E 4
Osimo* 27,936 D 4
Ostuni* 33,551 F 7
Otranto* 5,114 F 7
Pachino 21,394 I 6
Paderno* 43,963 B 2
Padua (Padova) 215,137 C 3
Pagani* 33,138 F 5
Palermo 698,556 H 4
Palma di Montechiaro* 24,077 I 5
Palmi 19,116 H 6
Parma 170,520 C 3
Partinico 27,182 H 4
Paterno 44,266 I 5
Pavia 76,962 C 2
Perugia 144,732 D 4
Pesaro 88,713 D 4
Pescara 122,236 E 5
Piacenza 102,268 C 2
Piazza Armerina 22,355 I 5
Pietra santa* 24,817 C 3
Pinerolo 35,331 C 1
Piombino 36,774 D 3
Pioltello* 34,165 B 2
Pisa 98,928 D 3
Pistoia 87,830 D 3
Poggibonsi* 26,364 D 4
Pomezia* 35,712 F 3
Pomigliano d'Arco* 43,089 F 5
Pompeii 25,177 F 5
Pontedera* 26,393 D 3
Pordenone 50,192 B 4
Portici* 68,980 F 5
Portoferraio 11,042 E 3
Portofino* 608 C 2
Portogruaro 24,760 B 4
Porto Torres 21,264 F 1
Positano* 3,638 F 4
Potenza 65,714 F 6
Pozzuoli* 75,142 F 5
Prato 165,707 D 3
Quartu Sant' Elena 61,636 G 2
Ragusa 67,535 I 5
Rapallo* 27,370 C 2
Ravello* 2,422 F 5
Ravenna 135,844 C 4
Recanati* 19,359 D 5
Reggio di Calabria 177,580 H 6
Reggio nell' Emilia 132,030 C 3
Rho* 51,848 B 2
Ribera* 21,004 I 4
Riccione* 32,909 D 4
Rieti 43,095 E 4
Rimini 127,960 D 4
Riva del Garda* 13,559 B 3
Rivoli 52,683 C 1
Rome (Roma) 2,775,250 E 4
Rosignano Marittimo 30,021 D 3
Rossano 33,694 G 6
Rovereto 32,923 B 3
Rovigo 52,472 C 3
Rozzano* 37,660 B 2
Salerno 148,932 F 5
Salsa-Maggiore Terme* 17,406 C 3
San Benedetto del Tronto 42,693 E 5
San Donà di Piave 33,446 B 4
San Gimignano* 6,956 D 4
San Giorgio a Cremano* 62,258 F 5
San Giovanni in Fiore 18,033 G 6
San Giovanni Rotondo* 24,378 E 6
San Marco in Lamis 15,221 E 6
San Remo 56,003 D 1
San Severo 55,085 E 6
Santa Maria Capua Vetere* 31,396 F 5
Sarno* 31,509 F 5
Saronno* 38,643 B 2
Sassari 122,339 F 1
Sassuolo 40,275 C 3
Savona 67,177 C 2
Scafati* 40,710 F 5
Scandicci* 53,523 D 3
Schio 36,351 B 3
Sciacca 38,256 I 4
Scicli* 25,255 I 5
Senigallia 41,144 D 4
Seregno* 38,588 B 2
Serra San Bruno* 6,759 H 6
Sessa Aurunca* 23,394 F 5
Sesto Fiorentino* 47,406 C 3
Sesto San Giovanni* 86,721 B 2
Sestri Levante* 20,470 C 2
Settimo Torinese* 45,984 C 1
Siena 56,956 D 3
Sondrio 22,097 B 2
Sora* 26,089 E 4
Sorrento 16,459 F 5
Spoleto 37,763 E 4
Sulmona 25,454 E 5
Syracuse (Siracusa) 125,941 I 6
Taormina 10,120 I 6
Taranto 232,334 F 7
Taurianova 16,056 H 6
Teramo 51,756 E 5
Termini Imerese 26,571 I 5
Terni 108,248 E 4
Terracina 37,077 F 4
Tivoli 52,372 E 4
Todi* 16,722 D 4
Torre Annunziata* 52,875 F 5
Torre del Greco 101,361 F 5
Torremaggiore* 17,405 E 5
Tortona* 27,220 C 2
Trani* 50,429 F 6
Trapani 69,497 H 4
Trento 101,545 B 3
Treviglio* 25,299 B 3
Treviso 83,598 B 4
Trieste 231,100 B 5
Turin (Torino) 962,507 C 1
Udine 99,189 B 4
Urbino 15,114 D 4
Valdagno* 27,449 B 3
Valdidentro* 3,708 B 3
Varese 85,687 B 2
Vasto 32,880 E 5
Velletri 43,423 F 4
Venice (Venezia) 309,422 B 4
Ventimiglia 25,308 D 1
Verbania 30,517 B 2
Vercelli 49,458 C 1
Vernli* 19,229 E 4
Verona 255,824 B 3
Viareggio 57,514 D 3
Vibo Valentia 34,836 H 6
Vicenza 107,454 B 3
Vigevano 60,384 C 2
Villa San Giovanni 12,785 H 6
Viterbo 58,380 E 4
Vittoria 55,280 I 5
Vittorio Veneto 29,231 B 4
Voghera 40,483 C 2
Volterra 12,879 D 3

*Does not appear on the map, key shows general location.
Source: 1991 census.

Italy
political map
National park (N.P.)
International boundary
Regional boundary
Expressway
Other road
Railroad
National capital
Regional capital
Other city or town
WORLD BOOK map
1
2
3
4
5
6
7
A
B
C
D
E
F
G
H
I
J
GERMANY
AUSTRIA
SWITZERLAND
LIECHTENSTEIN
FRANCE
SLOVENIA
CROATIA
BOSNIA-HERZEGOVINA
MONACO
SAN MARINO
VATICAN CITY
ITALY
TUNISIA
ALGERIA
MALTA
Corsica
(France)
Sardinia
Sicily
Belfort
Basel
Olten
Biel
Neuchâtel
Lucerne
Bern
Fribourg
Thun
Lausanne
Lake Geneva
Thonon
Sion
Martigny
Zurich
St. Gallen
Bludenz
Chur
St. Moritz
Garmisch-Partenkirchen
Kufstein
Saalfelden
Innsbruck
BRENNER PASS
TAUERN TUNNEL
Lienz
Salzburg
Bad Ischl
Kapfenberg
Leoben
Graz
Spittal
Wolfsberg
Villach
Klagenfurt
Drava
Maribor
Jesenice
Kranj
Varaždin
Ljubljana
Zagreb
Karlovac
Rijeka
Ogulin
Krk
Pula
Cres
Bihać
Gospić
Pag
Zadar
Knin
Ougi
Šibenik
Split
Sarajevo
Mostar
Neretva
Brač
Hvar
Vis
Korčula
Ploče
Mljet
Dubrovnik
Palagruža
SIMPLON TUNNEL
GREAT ST BERNARD TUNNEL
MT. BLANC TUNNEL
GRAN PARADISO N.P.
FRÉJUS TUNNEL
STELVIO N.P.
DOLOMITI BELLUNESI N.P.
Domodossola
Sondrio
Lugano
Verbania
Aosta
Valle D'Aosta
Varese
Como
Lecco
Bergamo
Busto Arsizio
Biella
Monza
Ivrea
Novara
Lombardy
Milan
Chivasso
Vercelli
Vigevano
Lodi
Pavia
Rivoli
Turin
Piedmont
Asti
Voghera
Alessandria
Novi Ligure
Pinerolo
Bra
Alba
Acqui
Cuneo
Genoa
Liguria
Chiavari
Savona
Gulf of Genoa
Alassio
Ventimiglia
Imperia
San Remo
Nice
Cannes
Riviera
Ligurian Sea
Merano
Bressanone
Bolzano
Cortina d'Ampezzo
Trentino-Alto Adige
Trento
Belluno
Friuli-Venezia Giulia
Vittorio Veneto
Udine
Rovereto
Conegliano
Pordenone
Gorizia
Monfalcone
Bassano del Grappa
Schio
Venetia
Treviso
Portogruaro
San Donà di Piave
Trieste
Vicenza
Verona
Lake Garda
Brescia
Padua
Venice
Gulf of Venice
Chioggia
Legnago
Mantova
Cremona
Rovigo
Piacenza
Parma
Carpi
Ferrara
Reggio nell' Emilia
Modena
Sassuolo
Bologna
Ravenna
Emilia
Imola
Faenza
Forli
Rimini
Cesena
APENNINE TUNNEL
Carrara
La Spezia
Massa
Viareggio
Pistoia
Prato
Pesaro
Pisa
Lucca
Florence
Urbino
Fano
Senigallia
Livorno
Empoli
Arno
Città di Castello
Iesi
Ancona
Gorgona
Volterra
Arezzo
Marches
Macerata
Rosignano Marittimo
Siena
Gubbio
Fabriano
Civitanova Marche
Tuscany
Cortona
Perugia
Fermo
Capraia
Piombino
Lake Trasimeno
Assisi
Foligno
MONTI SIBILLINI N.P.
Portoferraio
Ascoli Piceno
San Benedetto del Tronto
Grosseto
Umbria
Spoleto
Orvieto
Elba
Pianosa
Teramo
Pescara
Terni
Cape Corse
North
Calvi
Bastia
Corte
Ajaccio
Sartène
Porto-Vecchio
Monte Cristo
Giglio
Giannutri
Viterbo
Rieti
L'Aquila
Ortona
Chieti
Lanciano
Vasto
Abruzzi
Latium
Civitavecchia
Guidonia
Tivoli
Avezzano
Sulmona
ABRUZZO N.P.
Rome
Frosinone
Molise
San Severo
San Marco in Lamis
Monte Sant' Angelo
Manfredonia
Tremiti Is.
Adriatic Sea
Velletri
Cassino
Isernia
Campobasso
Foggia
Lucera
Nettuno
Anzio
Latina
Fondi
Formia
Cerignola
Barletta
Molfetta
CIRCEO N.P.
Terracina
Gaeta
Benevento
Caserta
Andria
Corato
Bari
Bitonto
Monopoli
Gulf of Gaeta
Afragola
Campania
Melfi
Apulia
Martina Franca
Brindisi
Naples
Avellino
Pompeii
Gravina di Puglia
Altamura
Matera
Ponza
Torre del Greco
Ischia
Salerno
Potenza
Francavilla Fontana
Mesagne
Sorrento
Capri
Amalfi
Eboli
Battipaglia
Basilicata
Taranto
Manduria
Lecce
Castellammare di Stabia
Gulf of Salerno
Pisticci
Nardò
Galatina
Point Licosa
POLLINO N.P.
Gulf of Taranto
Cape Santa Maria di Lauca
Castrovillari
Corigliano Calabro
Rossano
Point Alica
CALABRIA N.P.
Cosenza
San Giovanni in Fiore
Calabria
Crotone
Nicastro
Lamezia
Catanzaro
Asinara
La Maddalena
Tempio Pausania
Olbia
Porto Torres
Sassari
Alghero
Ozieri
Nuoro
Lake Omodeo
Cape of Monte Santu
Oristano
Guspini
Villacidro
Iglesias
Quartu Sant' Elena
Carbonia
Cagliari
Sant' Antioco
Cape Carbonara
Cape Spartivento
Tyrrhenian Sea
Ustica
Stromboli
Lipari Is.
Salina
Lipari
Vulcano
Vibo Valentia
Palmi
Taurianova
Messina
Villa San Giovanni
Reggio di Calabria
Cape Spartivento
Ionian Sea
Monreale
Palermo
Bagheria
Cefalù
Milazzo
Barcellona Pozzo di Gotto
Partinico
Trapani
Egadi Is.
Alcamo
Termini Imerese
Adrano
Taormina
Acireale
Marsala
Castelvetrano
Nicosia
Paternò
Mazara del Vallo
Caltanissetta
Enna
Catania
Sciacca
Agrigento
Canicatti
Piazza Armerina
Lentini
Augusta
Caltagirone
Licata
Gela
Syracuse
Ragusa
Vittoria
Avola
Modica
Pachino
Cape Passaro
Mediterranean Sea
Bizerte
Cape Bon
Annaba
Tunis
Bajah
Pantelleria
Nabul
Souk Ahras
Al Kaf
Sousse
Al Qayrawan
Pelagie Is.
Linosa
Lampione
Lampedusa
Valletta
36 North Latitude
0
100
200
300
400
500 Miles
500
600
700
800 Kilometers

Like the rest of Europe, Italy's population shows almost no annual growth. Fewer families are having more than two children. Families in southern Italy tend to have more children than those in northern Italy.

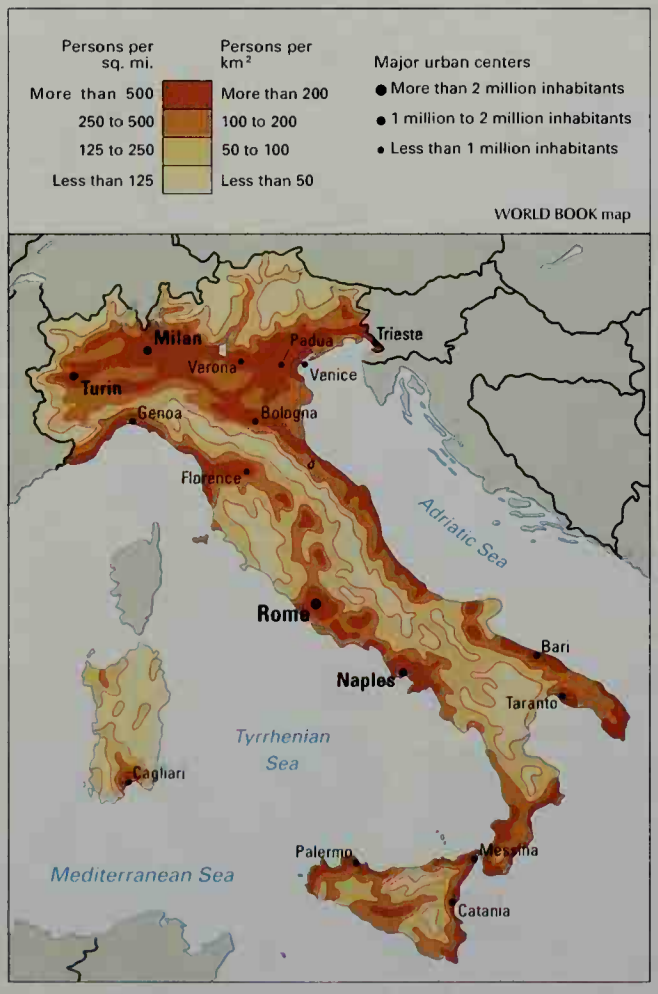
About 98 percent of Italy's people are ethnic Italians. The only sizable ethnic minorities are Germans who live in the Trentino-Alto Adige region, which borders Austria, and Slovenes who inhabit the Trieste area, along the border of Italy and Slovenia. A number of ethnic French people live in the Valle D'Aosta region, near Italy's border with France and Switzerland.

Language. Italian, like French and Spanish, is a *Romance* language—one of several languages that came from Latin. Standard Italian evolved from a dialect spoken in Tuscany. Its use in public schools and on television has helped make it the principal language of most Italians. Some people still speak regional dialects, which differ greatly from one another. See **Italian language**.

There are only a few communities in Italy in which Italian is not spoken as the first language. German is the first language of many people of the Trentino-Alto Adige region. French is spoken as a first language in portions of the northwestern part of Italy. *Slovenian,* a Slavic language, and *Ladin,* a language similar to the Romansh of the Swiss, are spoken in northern sections of Venetia.

Population density

The population of Italy is concentrated largely in the cities. The Po Valley in northern Italy is the most thickly populated part of the country.



Southern Italy has a few Greek- and Albanian-speaking communities.

Way of life

Life in northern Italy differs in many ways from that in southern Italy. The north is richer, more urbanized, and more industrial than the south. Service industries and manufacturing and construction employ the most people in both areas. But the percentage of people who work in agriculture is much higher in the south than in the north. In all parts of Italy, most people live in cities or towns. Italians are strongly attached to their towns, neighborhoods, and families. Many people who leave their home in search of greater opportunities hope to return eventually to their old communities.

City life. Most people who live in Italy's urban areas reside in concrete apartment buildings. A few wealthy people live in single-family homes. The oldest sections of an Italian city consist mostly of low buildings that have apartments around a central courtyard. Newer sections of the city often have large apartment buildings. Many residents buy rather than rent their apartments. Poor neighborhoods are usually located on the outskirts of the cities.

Most unmarried children live with their parents. Parents often help an adult son or daughter purchase an apartment near their own. Many young women work outside the home, and grandparents often help care for the children of working mothers. Many urban areas have public child-care centers.

City growth and the increased use of private automobiles have led to serious problems of urban pollution. In large cities, the air pollution problem poses a health hazard and has damaged priceless architecture. Bologna and several other cities have eased this problem by banning private cars from the city centers.

Rural life. In the past, most rural communities in Italy consisted of a compact settlement surrounded by a large area of agricultural land. Farmers usually lived in town and traveled to their fields each day. This pattern was especially common in southern Italy. In the north, many farmers lived on their land.

Most rural townspeople lived in apartment buildings. Only wealthy people had their own buildings, which were usually in the center of the community. Today, more and more single-family homes are being built in rural areas, often outside the old community center.

The population has declined in many rural areas of Italy—particularly in the mountains—as people have left to seek jobs in the cities. But the mountains have become increasingly popular with prosperous Italians as a location for summer homes. This interest has sparked a housing boom in many remote mountain communities.

Food and drink. Italians take great pride in the quality of their cooking. They traditionally eat their main meal at midday. Large meals usually consist of a pasta course, followed by a main course of meat or fish. Sometimes a course of *antipasto* (appetizers) is served before the pasta. The antipasto may consist of a variety of cold meats and vegetables, such as *prosciutto* (a type of spiced ham), salami, olives, and artichoke hearts.

Italian foods vary greatly by region. In the north, flat, ribbon-shaped pastas served with cream sauces are most popular. In the south, macaroni served with toma-

© Giovanna Nuvoletti, Grazia Neri

An Italian family shares a meal. Italians take great pride in their cooking. Popular Italian foods include pasta, and *risotto,* a rice dish with vegetables.

© George Hall, Woodfin Camp, Inc

Low-rise, concrete apartment buildings in Florence typify the housing in Italian cities. Many Italians buy rather than rent their apartments.

to-based sauces is the favorite type of pasta. Soups of all kinds may substitute for pasta as a first course. Another popular first-course dish is *risotto,* a rice dish with vegetables. The most popular meats are veal and pork. Cheeses are also important, either eaten alone or used in other dishes. Pizza is a popular snack and is also eaten as a light meal. Fresh fruit is a popular dessert. Traditionally, wine is served with every meal except breakfast.

Recreation. Italians enjoy a wide variety of sports. Soccer is the most popular sport in Italy. Every major city has a professional soccer team. But soccer is not just a spectator sport—on weekends Italy's parks are filled with children and adults playing the game. Basketball is also very popular, and some cities have more than one professional basketball team. Other popular sports include fishing, hunting, cycling, roller skating, and baseball.

Family recreational activities include taking a traditional Sunday *passeggiata* (family stroll), driving to the seashore or the mountains, and watching television. Italians enjoy going to the movies, but the growing popularity of TV has led to a decline in movie attendance.

Religion. About 95 percent of Italy's people are Roman Catholics. Most baptisms, weddings, and funeral services are held in church. But only about 30 percent of all Italians attend church regularly. Many others occasionally attend church. An agreement called a *concordat* governs the relationship between Italy and the Roman Catholic Church. For instance, the agreement exempts priests and other members of religious orders from military service and gives tax exemptions to Catholic organizations.

The Roman Catholic Church has had a strong influence on laws in the past, but that influence has weakened. For example, until 1970, the church was able to block attempts to legalize divorce in Italy. And in 1978, voters rejected the church's position and voted to allow abortions.

Vatican City, the spiritual and governmental center of the Roman Catholic Church, lies entirely within the city of Rome. But Vatican City is independent from Italy and has its own diplomatic corps.

There are several small religious groups in Italy. These groups include Protestants, Muslims, and Jews.

© Mathias Oppersdorff, Photo Researchers

Outdoor markets, such as this one in Naples, attract shoppers with colorful displays of fruits and vegetables. Fresh fruit is commonly eaten as a dessert in Italy.

© Dino Fracchia, Grazia Neri

Religion plays an important role in the lives of many Italians. The Roman Catholic Easter procession pictured here takes place annually in southern Italy.

Education. All children in Italy from age 6 to age 15 must attend school. More than 90 percent of them attend public schools. Through the Ministry of Education in Rome, the national government sets educational policies and selects the school system's curricula and books. The required schooling is divided into a five-grade elementary school followed by a three-year junior high school. After graduating from junior high school, students may attend one of many different kinds of senior high schools. Most of these schools offer four- or five-year programs of study. The largest group of students attend technical schools. Other high schools include vocational schools, science schools, classical schools, teacher training schools, and language schools.

Any senior high school graduate may attend a university. Italy has 47 public universities. The country also has a few private universities, most of which are run by the Roman Catholic Church. Together, the universities enroll more than a million students each year. Most university programs last from four to six years.

University enrollment has been very heavy since the late 1960's. The University of Rome, with an enrollment of about 170,000, is the largest university in Italy. The University of Bologna, which dates from about 1100, is one of the world's oldest universities.

Museums and libraries. Italy is one of the world's greatest centers of architecture, art, and books. Many of its art museums rank among the most famous in the world. Several of Italy's museums are the former palaces of kings or the houses of royal families. These museums include the Pitti Palace and the Uffizi Palace in Florence. National archaeological museums in Cagliari, Naples, and Palermo contain artifacts from the earliest history of Italy. Displays in the national galleries in Naples, Palermo, and Urbino include paintings by Italian masters.

All large Italian cities have public libraries. The largest libraries in Italy are the national central libraries in Florence and Rome. The one in Florence contains about 4 $\frac{1}{2}$ million volumes; the one in Rome, about 3 $\frac{1}{2}$ million volumes. In Italy, people visit libraries primarily for serious study. Local libraries have few popular books for general readers, and children's libraries are rare.

Arts

Italy has made important contributions to the arts since the early Middle Ages. The country's greatest artistic achievements came during the Renaissance, the cultural movement that began in the early 1300's and ended about 1600. During that time, Italy produced some of the greatest painters, sculptors, and architects in art history. Italian painters, sculptors, composers, and architects also dominated the *baroque* art movement that began near the end of the Renaissance and ended in the 1700's.

Architecture. Italy achieved its first international importance in architecture. Old St. Peter's Church (begun about A.D. 330) was probably the first significant early Christian *basilica,* a style of church architecture that came to dominate the early Middle Ages. Old St. Peter's stood on the site of the present St. Peter's Basilica in Rome. The first significant buildings in the medieval Romanesque style were churches built in Italy during the 800's. Several outstanding examples of the Byzantine architectural style of the Middle East also were built in Italy. The most famous Byzantine structure is the Basilica of St. Mark (begun in the mid-1000's) in Venice.

The greatest flowering of Italian architecture took place during the Renaissance. Filippo Brunelleschi made great contributions to architectural design with his dome for the Cathedral of Florence (completed in 1436). Leon Battista Alberti was another early Renaissance architect whose theories and designs had an enormous influence on later architects.

Perhaps the greatest achievement of Italian Renaissance architecture was St. Peter's Basilica, originally designed by Donato Bramante in the early 1500's. Andrea Palladio influenced architects throughout western Europe with the villas and palaces he designed in the middle and late 1500's.

The baroque period produced several outstanding Italian architects in the 1600's especially known for their churches. The most important architects included Gian Lorenzo Bernini and Francesco Borromini.

Modern Italian architects have also gained an international reputation. The best known is Pier Luigi Nervi, who gained fame for his skillful use of concrete.

For more information on Italian architects and structures, see **Architecture.**

Literature in the Italian language was shaped by three great writers of the 1300's—Dante, Petrarch, and Giovanni Boccaccio. Their language and their works were imitated by Italian writers for hundreds of years. Dante's *The Divine Comedy* is a masterpiece of world poetry. Boccaccio's *Decameron* is one of the most popular collections of short stories ever written. Petrarch's love poetry served as a model for centuries.

Italian Renaissance authors produced a number of important works. Among the best known is *The Prince,* a political science essay written by Niccolò Machiavelli in 1513 and published in 1532. Italian drama developed in the 1600's, especially in the style called *commedia dell'arte.* These comedies were based on the improvisation of certain characters and became very popular. In the 1700's, playwright Carlo Goldoni replaced commedia dell'arte with full written plays, many portraying the middle class of his day.

In the 1800's, Alessandro Manzoni wrote *The Betrothed* (1827, 1840), a famous historical novel. Manzoni was also an influential playwright. In the late 1800's, a realistic literary movement called *verismo* played a major role in Italian literature. Giovanni Verga was the leading author in this movement.

A movement called *futurism,* led by poet and novelist Filippo Tommaso Marinetti, influenced Italian writers in the early 1900's. The movement called for literature that would glorify the modern machine age. The leading Italian dramatist of the 1900's was Luigi Pirandello, known for his philosophical plays. Salvatore Quasimodo and Eugenio Montale were leading modern poets.

For more information, including a list of notable Italian authors, see **Italian literature** and its listing of *Related articles.*

Music. Italian composers have played a major role in music since the Middle Ages. In the 1000's, Guido d'Arezzo, an Italian monk, developed a revolutionary system of notation and method of sight-singing.

During the Renaissance, Giovanni Palestrina composed masterpieces of choral music for use in church services. The first operas were composed in Florence in

the 1590's. Opera emerged as an art form during the baroque period. Claudio Monteverdi was the first great composer of baroque opera in the early 1600's. Important composers of the late 1600's and early 1700's included Alessandro Scarlatti, his son Domenico, and Antonio Vivaldi. Alessandro became best known for his operas, Domenico for his keyboard compositions, and Vivaldi for his works for violin. During the 1800's and early 1900's, popular operas were composed by Giuseppe Verdi, Giacomo Puccini, Vincenzo Bellini, Gaetano Donizetti, and Gioacchino Rossini.

For more information, including a list of important Italian composers, see **Classical music** and its listing of *Related articles.*

Marble statue (1513-1516) in the Church of St. Peter in Chains, Rome (SCALA/Art Resource)

Renaissance sculpture developed in Italy during the 1400's and 1500's. Michelangelo produced many great works, including this famous statue of Moses.

Fountain of the Four Rivers (1651) by Gian Lorenzo Bernini in front of the Church of Sant' Agnese in Piazza Navona (1666) by Francesco Borromini and others (SCALA/Art Resource)

Baroque art originated in Rome during the late 1500's. The architecture features curved forms and intricate columns. The sculpture is ornate and dramatic.

Corning Museum of Glass, Corning, New York

Beautiful glassware has been manufactured on the Venetian island of Murano since the 1200's. The goblet shown here was made in the early 1500's.

© Lelli & Masotti, La Scala Theatre

Italian opera is performed at La Scala, a famous opera house in Milan. Opera began in Florence in the 1590's. This picture shows a performance of Pietro Mascagni's *Cavalleria rusticana.*

Dancers in Blue Dress (1912), an oil painting by Gino Severini; Mattioli Collection, Milan (SCALA/Art Resource)

Futurism was an important Italian art movement of the early 1900's. Futurist painters used multiple images to glorify the energy and excitement of modern life.

Painting and sculpture. The Italian Renaissance produced many of the greatest painters and sculptors in art history. They were all influenced by the work of Giotto in the late 1200's. One of the most influential artists who ever lived, Giotto changed the course of Western art by painting in a new realistic style.

Florence became the center of early Renaissance art. The great Florentine masters of painting included Masaccio, Fra Angelico, Andrea Mantegna, Sandro Botticelli, and Paolo Uccello. The greatest artist of the 1400's was probably Leonardo da Vinci. His portrait *Mona Lisa* and his religious scene *The Last Supper* are among the most famous paintings in history.

Early Renaissance sculptors equaled the painters in achievement. The major sculptors included Donatello, Antonio del Pollaiuollo, and Andrea del Verrocchio.

The later Renaissance was dominated by Raphael and Michelangelo. Raphael painted balanced, harmonious pictures that expressed a calm, noble way of life. Michelangelo achieved greatness both as a painter and sculptor. He even helped design St. Peter's Basilica. In Venice, a number of artists were painting richly colored works during the 1500's. The most famous Venetian masters included Giorgione, Titian, and Tintoretto.

Italian painters and sculptors dominated the baroque period. Annibale Caracci and Michelangelo Caravaggio were the most important early baroque painters. Gian Lorenzo Bernini was the greatest master of European sculpture of the baroque period.

In the 1900's, many Italians played leading roles in the development of modern art. Umberto Boccioni was a founder and the leading sculptor of the futurism movement. Giorgio de Chirico gained fame for his haunting paintings of empty city squares. Amedeo Modigliani won renown with a series of brilliantly painted portraits.

For more information, including lists of important Italian artists, see **Painting** and **Sculpture** and their listings of *Related articles.*

Motion pictures. The early Italian film industry became internationally known for its historical spectacles, most made from 1905 to 1914. Few major motion pictures were produced during the 1920's and 1930's, but a renaissance of Italian filmmaking developed in the 1940's. At that time, a new generation of directors emerged. They included Vittorio De Sica, Alberto Lattuada, Roberto Rossellini, and Luchino Visconti. After the end of World War II in 1945, several of these directors became leaders in a movement called Neorealism, which portrayed the daily life of ordinary people with almost documentary realism.

During the 1950's and 1960's, earthy comedies gained international success, due partly to the popularity of Italian movie stars Gina Lollobrigida, Sophia Loren, and Marcello Mastroianni. At the same time, a new group of directors won praise. The most significant were Michelangelo Antonioni and Federico Fellini. De Sica, Rossellini, and Visconti also continued to film major works. During the late 1900's, the leading Italian directors included Roberto Begnini, Marco Bellocchio, Bernardo Bertolucci, and the brothers Paolo and Vittorio Taviani.

The land

Italy has eight land regions: (1) the Alpine Slope, (2) the Po Valley, (3) the Adriatic Plain, (4) the Apennines, (5) Apulia and the Southeastern Plains, (6) the Western Uplands and Plains, (7) Sicily, and (8) Sardinia.

The Alpine Slope runs across the northernmost part of Italy. Its landscape includes huge mountains and deep valleys. Forests of beech, oak, and chestnut trees grow at the lower levels of the mountains. Higher levels feature grasslands and conifer forests. Only low bushes grow at still higher elevations, and the highest mountaintops have only rocks and glaciers. Melting snow from the Alps feeds many rivers. Hydroelectric plants along Alpine rivers provide much of Italy's electric power. The people of the Alpine region live in small, scattered communities, and make their living by farming and herding. Many tourists visit the Alps to ski.

The Po Valley, also called the *North Italian Plain,* is a broad plain that stretches between the Alps in the north and the Apennine mountains in the south. Waterways fed by melting snows from these mountains cross the valley. They feed into Italy's longest river, the Po, which forms the center of the valley. The Po floods periodically, but a system of dikes controls the flooding.

© Marcello Bertinetti, Photo Researchers

The Alps form a towering wall across northern Italy. The tallest of these mountains have only rocks and glaciers at their peaks. Melting snows from the Alps feed many of Italy's rivers.

Physical features

Acrae (ruins) ..... G 5
Adda River ..... A 2
Adige River ..... A 3
Adriatic Sea ..... C 5
Alps (mountains) ..... A 2
Apennines (mountains) ..... C 4
Arno River ..... C 3
Brenner Pass ..... A 3
Cape Carbonara ..... F 2
Cape Passero ..... G 5
Cape Santa Maria di Leuca ..... E 7
Capraia (island) ..... C 2
Capri (island) ..... E 5
Carso (plateau) ..... A 4
Corno Grande (mountain) ..... D 4
Cottian Alps (mountains) ..... B 1
Dolomites (mountains) ..... A 4
Egadi Islands ..... G 4
Elba (island) ..... C 3
Giannutri (island) ..... D 3
Giglio (island) ..... D 3
Gorgona (island) ..... C 2
Gran Paradiso (mountain) ..... A 1
Great St. Bernard Pass ..... A 1
Gulf of Genoa ..... B 2
Gulf of Manfredonia ..... D 6
Gulf of Naples ..... E 5
Gulf of Salerno ..... E 5
Gulf of Taranto ..... E 7
Gulf of Trieste ..... A 4
Gulf of Venice ..... B 4
Ionian Sea ..... G 7
Ischia (island) ..... E 4
Lake Alhano ..... D 4
Lake Bolsena ..... D 4
Lake Bracciano ..... D 4
Lake Como ..... A 2
Lake Garda ..... A 3
Lake Lugano ..... A 2
Lake Maggiore ..... A 2
Lake Trasimeno ..... C 4
Lake Varano ..... D 6
Le Murge (plateau) ..... E 6
Ligurian Sea ..... C 2
Lipari Islands ..... F 5
Lombardy Plains ..... B 2
Maritime Alps (mountains) ..... B 1
Monte Cristo (island) ..... D 3
Mount Amaro ..... D 5
Mount Amiata ..... C 3
Mount Cimone ..... B 3
Mount Etna ..... G 5
Mount Pollino ..... E 6
Mount Viso ..... B 1
Ofanto River ..... D 6
Oglio River ..... B 3
Ortles (mountain) ..... A 3
Paestum (ruins) ..... E 5
Panaro River ..... B 3
Pantelleria (island) ..... G 4
Pescara River ..... D 5
Piave River ..... A 4
Po River ..... B 3
Point Gargano ..... D 6
Pompeii (ruins) ..... E 5
Pontine Marshes ..... D 4
Punta La Marmora (mountain) ..... E 2
Reno River ..... B 3
Riviera (coast) ..... C 1
Segesta (ruins) ..... G 4
Selinunte (ruins) ..... G 4
Strait of Bonifacio ..... D 2
Strait of Messina ..... G 6
Strait of Otranto ..... E 7
Strait of Sicily ..... G 3
Tanaro River ..... B 2
Taro River ..... B 3
Ticino River ..... A 2
Tiber River ..... D 4
Tremiti Islands ..... D 6
Tyrrhenian Sea ..... F 4
Ustica (island) ..... F 4
Valli di Comacchio (lagoon) ..... B 4
Vesuvius (volcano) ..... E 5

© Adam Woolfitt, Woodfin Camp, Inc.

Sicily is an island that lies just off the "toe" of the boot-shaped Italian peninsula. Hills and mountains cover most of the island. Palermo, Sicily's largest city and chief seaport, is visible toward the top of this photograph.

The Po Valley is the richest and most modern agricultural region in Italy, and its land is almost totally cultivated. It is also Italy's most densely populated region, with many cities and a growing number of industrial suburban towns. Milan and Turin, in the western part of the valley, are at the center of the most heavily industrialized part of Italy. In the east, the Po River drains into the Adriatic Sea, forming a vast delta region of lagoons, ponds, and marshes. During the 1800's, much of this land was drained and turned into farmland.

The Adriatic Plain is a small region north of the Adriatic Sea. Its eastern edge borders Slovenia. The plain's eastern half is known as the Carso. It is a limestone plateau and is not good for farming.

The Apennines stretch almost the entire length of Italy. These mountains have steep inclines of soft rock that are constantly eroding as a result of heavy rains, overgrazing of sheep and goats, and the clearing of forests for wood and cropland. The lower mountain levels are covered with oak forests, which have been cleared in many places to allow farming. The middle levels feature beech and conifer forests. The highest slopes have only wooded scrubland. The Arno and Tiber rivers flow from the Apennines to the Tyrrhenian Sea.

The northern Apennines have some of the largest forests in the country and much pastureland. The central part of the range has productive farmland and grazing. The southern Apennines include the poorest part of Italy, from Molise to Calabria. This area has plateaus and high mountains, and offers few natural resources.

Apulia and the Southeastern Plains form the "heel" of the boot-shaped Italian peninsula. This region is composed of plateaus that end as cliffs at the Mediterranean Sea. It has many large farming estates, and produces more olive oil than any other region of Italy. Fishing is important along the coast. Bari and Taranto, two port cities, are the chief industrial centers.

The Western Uplands and Plains stretch along the Tyrrhenian Sea from La Spezia, a port city just south of Genoa, southward past Naples to Salerno. It is a rich agricultural region, second only to the Po Valley in agricultural production. The northern portion of the region includes the rich hill country of Tuscany and Umbria. This area is known especially for its grain crops and livestock. The southern half of the Western Uplands and Plains includes the cities of Rome and Naples. The plain along the coast is densely populated. In the warm climate of the coastal plain, farmers grow apricots, cherries, lemons, peaches, and vegetables. Vineyards are found throughout the entire region.

Sicily is the largest island in the Mediterranean Sea. It is separated from mainland Italy by the Strait of Messina. The island has mountains and plains. Mount Etna, one of the largest active volcanoes in the world, dominates the landscape of northeastern Sicily. Severe erosion, caused in part by the clearing of forests, has hampered agriculture and made travel in many inland areas difficult during the wet season. Wheat farming and sheep and goat herding are important in the interior of the island. Sicily has the largest fishing industry in Italy. Since the end of World War II in 1945, several of Sicily's cities have attracted industrial enterprises.

© Rene Sheret from Marilyn Gartman

The Western Uplands and Plains form a rich agricultural region. The area produces much of Italy's grain, livestock, fruits, and vegetables. Farmers throughout the region grow grapes.

Sardinia is an island to the west of the Italian peninsula in the Tyrrhenian Sea. Its landscape is dominated by mountains and high plateaus. The only good farmland is in the low-lying coastal plains, where cereals, artichokes, and grapes are grown. The most heavily populated areas of Sardinia are along these coastal plains.

Climate

Italy is often called "Sunny Italy," but this description is only partly true. Spring, summer, and fall are generally sunny, but winter is rainy and cloudy.

In early spring, hot, dry air from the Sahara expands across the Mediterranean Sea northward to the Alps and covers Italy. The summer climate of much of Italy is dry, with occasional rainstorms. In fall, the Saharan air mass contracts, and cool moist air from the Atlantic Ocean flows eastward over the country. Winters are cold and snowy on the upper slopes of the Alps and the Apennines. Along the Mediterranean Sea, the days are usually warm. The climate does not vary greatly between the north and the south, except in winter. Northern Italy is protected from intense cold by the Alps.

The north has enough rain to raise crops, often 30 inches (76 centimeters) or more a year, but dryness increases to the south. Southern Sicily has only about 15 inches (38 centimeters) of rain a year.

Average monthly weather

Rome	Temperatures °F		Temperatures °C		Days of rain or snow
	High	Low	High	Low	
Jan.	54	39	12	8	12
Feb.	56	39	13	11	11
Mar.	62	42	17	5	10
Apr.	68	46	20	6	8
May	74	55	23	6	9
June	82	60	28	3	7
July	88	64	31	2	2
Aug.	88	64	31	3	2
Sept.	83	61	28	6	3
Oct.	73	53	23	9	7
Nov.	63	46	17	8	10
Dec.	56	41	13	9	12

Milan	Temperatures °F		Temperatures °C		Days of rain or snow
	High	Low	High	Low	
Jan.	40	29	4	−2	7
Feb.	47	33	8	1	6
Mar.	56	38	13	3	6
Apr.	66	46	19	8	6
May	72	54	22	12	9
June	80	61	27	16	6
July	84	64	29	18	6
Aug.	82	63	28	17	6
Sept.	76	58	24	14	6
Oct.	64	49	18	9	7
Nov.	51	39	11	4	7
Dec.	42	33	6	1	7

Economy

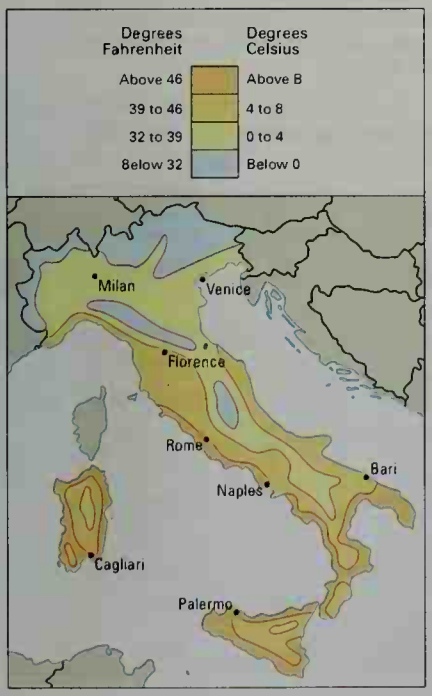
Since World War II (1939-1945), Italy has shifted from a predominantly agricultural economy to one based on modern industries. As recently as 1953, more than 30 percent of all Italians were employed in agriculture. Today, less than 10 percent of employed Italians work in agriculture. The transformation has been most complete in northern Italy, which is now one of the most advanced industrial areas of Western Europe. Southern Italy remains poorer and less industrialized, despite long-term efforts of the Italian government to improve the region's industry and agriculture.

In the 1950's, Italy helped found the European Coal and Steel Community, the European Atomic Energy Community, and the European Economic Community. These groups became the basis of the European Community (EC), an economic association of European nations. Italy's economy was strengthened through increased trade with other EC members. In 1993, Italy and the other EC countries formed the European Union, which works for both economic and political cooperation among its member nations. The EC was incorporated into the European Union (see **European Union**).

The Italian government owns a large portion of many

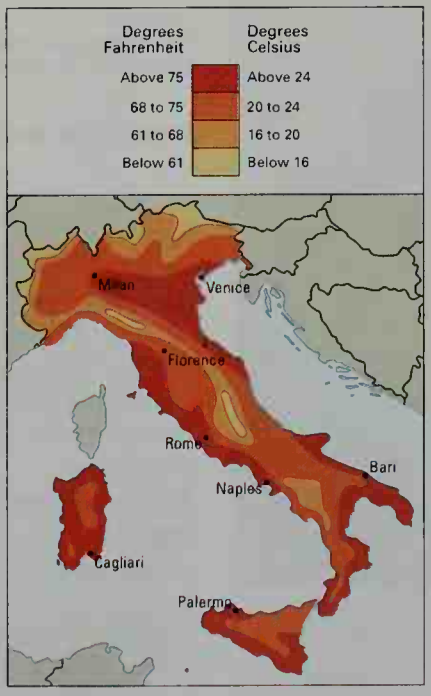
Average January temperatures

In winter, Italy has mild temperatures in the south and cooler temperatures in the mountainous regions of the north.



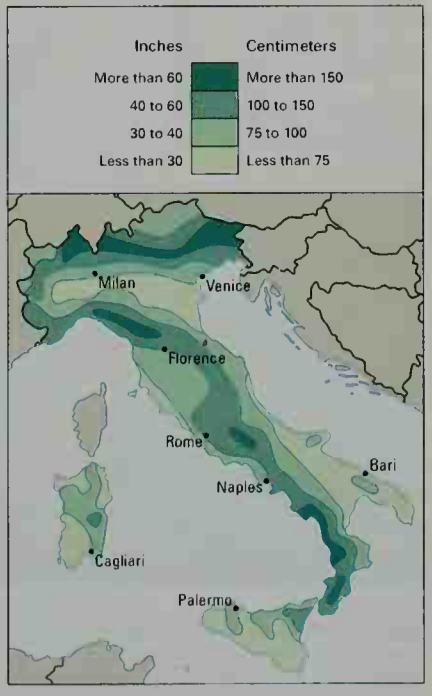
Average July temperatures

In summer, Italy's climate is uniformly sunny and mild. The temperatures are warmest in the coastal and lowland areas.



Average yearly precipitation

Italy's precipitation is heaviest in winter and lightest in summer. Rainfall in Italy decreases from north to south.



WORLD BOOK maps

© Sipa Press

A fashion show in Milan offers a preview of clothing designs. The Italian fashion industry helps set clothing styles throughout the world. Clothing is one of Italy's main exports.

© Eric Futran from Marilyn Gartman

On the canals of Venice, tourists enjoy riding in *gondolas* (narrow boats). Venice, with canals for streets, attracts visitors from around the world. Tourism is important to Italy's economy.

companies. The government began selling many of its holdings to private investors in the 1990's, but it still controls all energy production.

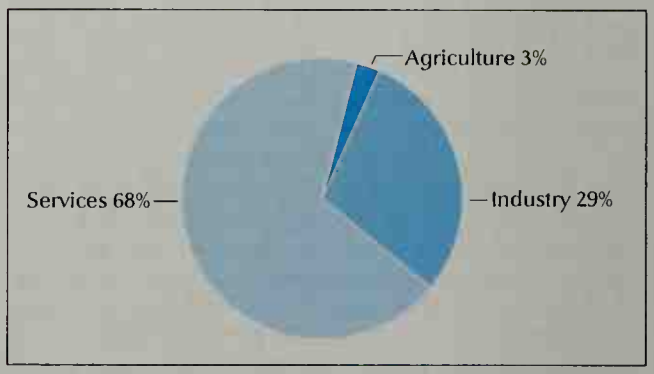
Italy has few natural resources. Its most important resource is the rich farmland of the Po Valley. Other important croplands are the volcanic soils and clays of the south and of Sicily. Italy also has valuable forestland on the Alpine slopes and on Sardinia.

Service industries are economic activities that provide services rather than produce goods. In Italy, they account for about two-thirds of the *gross domestic product (GDP).* The GDP is the total value of goods and services produced within the country in a year.

Trade, restaurants, and hotels form one of Italy's leading service industry groups. Businesses in this category benefit from Italy's reputation as a center for fashion, good food, and natural and historic beauty. Information on international trade appears later in this section.

Government services include public administration and military activities. Another service industry group, community, social, and personal services, includes such

Italy's gross domestic product



Italy's gross domestic product (GDP) was $1,170,999,000,000 in 1999. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, social, and personal services; finance, insurance, real estate, and business services; government; trade, restaurants, and hotels; and transportation and communication. *Industry* includes construction, manufacturing, mining, and utilities. *Agriculture* includes agriculture, forestry, and fishing.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers	
		Number of people	Percent of total
Manufacturing & mining	25	4,998,000	24
Community, social, & personal services	25	1,099,000	5
Government*	19	4,677,000	22
Trade, restaurants, & hotels	17	4,047,000	20
Transportation & communication	7	1,133,000	5
Construction	5	1,575,000	8
Agriculture, forestry, & fishing	3	1,135,000	5
Utilities	3	176,000	1
Finance, insurance & real estate	†	2,007,000	10
Total	100	20,847,000	100

*Figures include education and health care.
†Included in Community, social, and personal services. Figures are for 1999.
Sources: Istituto Nazionale di Statistica, Rome; International Labour Organization; International Monetary Fund.

establishments as schools, data processing centers, and law firms. It also includes health care. Italy has excellent medical facilities. The country also has a national health plan that provides low-cost medical care to all people.

Italy's service industries—particularly retail trade and personal services—are greatly aided by tourism. About 50 million tourists visit Italy each year. They contribute billions of dollars to the economy annually.

Other service industries include finance, insurance, and real estate; and transportation and communication. Transportation and communication are discussed later in this section.

Manufacturing. Manufacturing accounts for almost a fourth of Italy's gross domestic product and employs about a quarter of the nation's work force. Clothing, including shoes, ranks as the leading type of manufactured product in Italy. Other important manufactured goods, in order of value, include textiles, processed foods, petroleum products, electrical and nonelectrical machinery, automobiles, and chemicals.

Despite government efforts to develop greater industry in the south, most of Italy's manufacturing takes place in the northwestern part of the country, in the triangle formed by Milan, Turin, and Genoa. The country's large manufacturing firms include ENI, a petroleum company; and Fiat, an automobile manufacturer.

The Italian government once controlled many large manufacturing companies, including steel mills and shipyards. In the 1990's, the government sold most of its holdings to private companies.

Agriculture. About 40 percent of Italy's land is cultivated. Most Italian farms are small—about three-fourths of them are less than 12 acres (5 hectares). Most farmers own their land. Some of Italy's agriculture has been modernized, but much of it remains poor, especially in the south and in the mountain areas.

Grapes are Italy's most valuable crop. Most of the grapes are used to make wine. Italy is a leading wine-producing country, and Italian wines are exported throughout the world. Italy also produces many olives. Most are used to make olive oil, another valuable export. Other fruit and vegetable crops include oranges, peaches, apples, tomatoes, and potatoes. Italy is also one of the world's largest producers of sugar beets, and more than half the world's artichokes come from Italy. Important grain crops include wheat, corn, and rice.

Farmers in Italy raise cattle, hogs, chickens, and sheep. But Italians consume more meat than the country's farmers produce. Much of Italy's meat is imported from other countries, especially Argentina.

Economy of Italy

Italy has a modern industrial economy. Most of the country's manufacturing takes place in the north, particularly in the triangle formed by Turin, Milan, and Genoa. This map shows Italy's manufacturing centers, croplands, forestlands, mineral deposits, and fishing products.

WORLD BOOK map

© Bruno Rizzato, Grazia Neri

Automobiles rank among Italy's most profitable exports. The assembly-line worker pictured above is working at a Fiat automobile plant. Fiat is Italy's largest carmaker.

© John Sims, TSW Click/Chicago

Grapes for wine, such as these being harvested in the region of Tuscany, are grown throughout Italy. Other important agricultural products include olives, wheat, and tomatoes.

The Po Valley is the richest agricultural region of Italy. It is Italy's principal area for livestock and dairy farming. The chief crops of the Po Valley include grains, grapes, olives, and sugar beets.

Mining. Italy has limited mineral deposits and so it relies on imports for much of its mineral needs. Most of Italy's mineral deposits are found on the islands of Sicily and Sardinia and in the regions of Tuscany, Lombardy, and Piedmont in the north-central and northwestern parts of the peninsula. Italy's most valuable mined product is natural gas, which comes from the Po Valley. The country also produces large quantities of marble and granite. Other important minerals mined in Italy include feldspar, pumice, and sulfur.

Energy sources. Italy depends heavily on other countries for its energy supply. Imported petroleum provides more than half of Italy's energy. Libya and Iran are Italy's largest suppliers of crude oil.

Italy itself produces only small amounts of petroleum. Most of the country's petroleum deposits are in Sicily. The National Hydrocarbon Agency controls the production and distribution of petroleum and natural gas. Italians rely heavily on natural gas for heating and other needs. Large amounts of natural gas from the Po Valley are piped into the cities of the north. Plants that burn oil provide most of Italy's electric power. Hydroelectric plants, most common in the north, contribute about a quarter of the country's electrical supply.

Trade. Italy engages in a great deal of international trade, more than half of which is with other members of the European Union. Italy's principal trading partners, in order, are Germany, France, the United States, and Britain. The country's main exports include clothing and shoes, motor vehicles, machinery, chemicals, and fruits and vegetables. Its chief imports are machinery, petroleum, motor vehicles, textile yarns, metals, and food. Milan is Italy's center of international commerce.

Since the early 1980's, Italy has had an unfavorable balance of trade—that is, the cost of its imports has exceeded the value of its exports. This imbalance results largely from the high cost of imported petroleum. Spending by foreign tourists helps balance this deficit.

Transportation. Italy has an excellent system of roads. Modern superhighways run the length of the Italian peninsula. Tunnels through the Alps link the highway system to those of neighboring countries. Italy has an average of about 1 car for every 3 people.

Railroad lines connect all the major cities of Italy. A high-speed railway links Rome, Florence, and Milan. The government owns most of Italy's railroads.

Italy's busiest airport is the Leonardo da Vinci International Airport in Fuimicino, near Rome. Linate and Malpensa airports in Milan also handle many passengers. The country's national airline, Alitalia, is owned mostly by the government.

Italy has one of the largest merchant shipping fleets in the world. The country's major ports include Genoa, Trieste, and Augusta. Inland shipping is important only in the north, where a network of canals links the Po River with the north lakes.

Communication. Until 1976, Italy had only three television stations and three radio stations. All of these stations were part of Radiotelevisione Italiana, a government-owned broadcasting company. In 1976, the government's monopoly on broadcasting was abolished. Since then, about 450 privately owned television stations and 1,000 privately owned radio stations have gone into operation. Italy has an average of about 1 radio per person and 1 television set for every 2 people.

Italy has about 70 daily newspapers, representing many social and political viewpoints. Many are published by political parties or by the Roman Catholic Church, but most are owned by large companies. The most widely read newspapers in Italy are Milan's *Corriere della Sera,* Turin's *La Stampa,* and Rome's *La Repubblica.*

History

End of the Roman Empire. For nearly 1,500 years, starting about 1000 B.C., the history of Italy was largely

the history of the Etruscans and of ancient Rome (see **Etruscans; Rome, Ancient**). The last Roman emperor, Romulus Augustulus, was defeated in Italy in A.D. 476 by a Germanic leader, Odoacer. His defeat marked the end of the western part of the Roman Empire. During most of the period from the fall of Rome until the Kingdom of Italy was established in 1861, the peninsula was divided into several smaller states. These states were frequently conquered by other countries.

The Middle Ages. Odoacer ruled well for 13 years after gaining control of Italy in 476. Then he was attacked and defeated by Theodoric, the king of another Germanic tribe, the Ostrogoths. Theodoric and Odoacer ruled jointly until 493, when Theodoric murdered Odoacer. Theodoric continued to rule Italy with an army of Ostrogoths and a government that was mostly Italian. He brought peace to the country, but after his death in 526, the kingdom began to grow weak. By 553, Justinian I, the Byzantine emperor who ruled the eastern part of the Roman Empire, expelled the Ostrogoths (see **Byzantine Empire**). The old Roman Empire was united again. But Byzantine rule in Italy collapsed by 572 as a result of invasions by another Germanic tribe, the Lombards.

During the 400's and 500's, the popes increased their influence in both religious and political matters in Italy. It was usually the popes who led attempts to protect Italy from invasion or to soften foreign rule. For about 200 years the popes opposed attempts by the Lombards, who had captured most of Italy, to take over Rome as well. The popes finally defeated the Lombards with the aid of two Frankish kings, Pepin the Short and Charlemagne (see **Pepin the Short; Charlemagne**). Using land won for them by Pepin in 756, the popes established political rule in what were called the Papal States in central Italy (see **Papal States**).

The Lombards remained a threat to papal power, however, until they were crushed by Charlemagne in 774. Charlemagne added Lombardy to his vast realm. In recognition of Charlemagne's power, and to cement the church's alliance with him, Charlemagne was crowned emperor of the Romans by Pope Leo III in 800.

After Charlemagne's death in 814, his son Louis I succeeded him. Louis divided the empire among his sons,

WORLD BOOK map

Italy about 1200. Northern Italy was part of the Holy Roman Empire, although several city-states had achieved near independence. The Kingdom of the Two Sicilies was a possession of the Holy Roman Emperor. The pope ruled the Papal States.

who fought each other for territory. Such battles continued until Otto the Great, the king of Germany, was crowned emperor in 962. This marked the beginning of what later was called the Holy Roman Empire.

Rise of the city-states. From the 1000's on, Italian cities began to grow rapidly in independence and importance. They became centers of political life, banking, and foreign trade. Some became wealthy, and many, including Florence, Genoa, Milan, Pisa, and Venice, grew into nearly independent *city-states*. Each had its own foreign policy and political life. They all resisted the efforts of noblemen and emperors to control them.

During the 1300's and 1400's, some Italian city-states

Important dates in Italy

476 Odoacer defeated the last emperor of ancient Rome, Romulus Augustulus.

800 Pope Leo III crowned Charlemagne emperor of the Romans.

962 Otto the Great was crowned emperor, marking the start of what later was called the Holy Roman Empire.

1000 Italian city-states began to grow in wealth and political importance.

c.1300 The Renaissance began in Italy.

1519 King Charles I of Spain became emperor of the Holy Roman Empire.

1521-1559 The forces of Spain and the Holy Roman Empire defeated France in a series of wars to control Italy.

1796 Napoleon Bonaparte seized Italy for France.

1814-1815 The Congress of Vienna returned Italy to its former rulers after Napoleon was defeated.

1861 The Kingdom of Italy was formed.

1866 Venetia became part of Italy.

1870 Rome became part of Italy.

1871 Rome became the capital of Italy.

1915-1918 Italy fought on the Allies' side in World War I.

1922 Benito Mussolini became prime minister.

1936 Italy conquered Ethiopia.

1940 Italy entered World War II on Germany's side.

1943 Italy surrendered to the Allies.

1946 The Republic of Italy was established.

1978 Red Brigades kidnapped and killed Aldo Moro, president of the Christian Democratic Party.

1980 An earthquake struck southern Campania and Basilicata, killing over 4,500 people.

1987 An organized crime trial in Palermo ended in the conviction of 338 Mafia members.

1996 For the first time in Italy's history, a coalition dominated by former Communists won the largest number of seats in Parliament.

WORLD BOOK map

Italy about 1500 was composed of independent city-states, which had begun to develop in the 1000's. Weakened by their lack of unity, the Italian city-states fell under foreign domination during the 1500's.

ranked among the most important powers of Europe. However, the city-states were often troubled by violent disagreements among their citizens. The most famous division was between the *Guelphs* and *Ghibellines*. The Guelphs supported supreme rule by the pope, and the Ghibellines favored the emperor. City-states often took sides and waged war against each other. This weakened the city-states and resulted in their capture by foreign invaders. See **Guelphs and Ghibellines.**

Life in the city-states contributed to the Renaissance, which developed in Italy after 1300 (see **Renaissance**). The cities supported the arts, and artists experimented with new ideas. Italian thought and Italian styles in art, literature, political theory, religion, and science influenced nearly every area of European activity.

During the Renaissance, Italy became an even more attractive prize to foreign conquerors. After some city-states asked for outside help in settling disputes with their neighbors, King Charles VIII of France marched into Italy in 1494. The city-states could not hold back the French army. Charles soon withdrew, but he had shown that the cities of Italy could be conquered because they were not united. For many years, France and the Holy Roman Empire fought for control of Italy.

Spanish and Austrian rule. In 1519, King Charles I of Spain, a member of the Habsburg family, became Emperor Charles V of the Holy Roman Empire. The power of Charles V lay chiefly in the riches of the lands under Spanish control. In 1521, the first in a series of wars broke out between Charles and Francis I of France over rival claims for territory. Charles's troops looted Rome in 1527 and later took Milan and Sicily from France. By 1559, almost all of Italy was under the influence of Spain. By the late 1500's, however, Spanish power had begun to decline. Dominance over Italy passed from the Spanish Habsburgs to the Austrian Habsburgs by the early 1700's. During the 1700's, Austria governed Milan and controlled most of the rest of Italy through local rulers who were loyal to the Austrian king. Although Italy was still an important center for the arts and sciences and shared in international intellectual movements, it no longer had an active role in European politics.

The French Revolution and Napoleon influenced Italy more deeply than they affected any other country

Journey of the Magi (1549), a fresco by Benozzo Gozzoli; Medici-Riccardi Palace, Florence (SCALA/Art Resource)

Powerful princes ruled Italian city-states during the Renaissance. One of the most famous, Lorenzo de Medici (right of center, on horse), governed Florence during the middle and late 1400's. Medici supported the arts, and under his rule, Florence became an important cultural center as well as one of the most powerful states in Italy.

of Europe, except France. The French Revolution began in 1789 and immediately found supporters among the Italian people. The local Italian rulers, sensing danger in their own country, drew closer to the European kings who opposed France. After the French king was overthrown and France became a republic, secret clubs favoring an Italian republic were formed throughout Italy. The armies of the French Republic began to move across Europe. In 1796, Napoleon Bonaparte led a French army into northern Italy and drove out the Austrian rulers (see **Napoleon I**). Once again, Italy was the scene of battle between the Habsburgs and the French. Wherever France conquered, Italian republics were set up, with constitutions and legal reforms. Napoleon made himself emperor in 1804, and part of northern Italy became the Kingdom of Italy under his rule. The rest of northern Italy was added to France. Only Sicily and Sardinia remained free of French control.

French rule lasted less than 20 years, and it differed from previous foreign control of the Italian peninsula. In spite of heavy taxation and frequent harshness, the French introduced representative assemblies and new laws that were the same for all parts of the country. For the first time since the days of ancient Rome, Italians of different regions used the same money and served in the same army. Many Italians began to see the possibility of a united Italy free of foreign control.

Napoleon abdicated in 1814 after being defeated by the major powers of Europe. These nations then attempted to establish a new order in Europe. Their representatives met at the Congress of Vienna and decided to reestablish Italy's former rulers in most cases. The royal House of Savoy returned to rule the region of Piedmont in the northwest and the island of Sardinia. These areas together were called the Kingdom of Sardinia. Because its center of government was in Piedmont, in Turin, the kingdom is often referred to simply as Piedmont. In the south, Naples and Sicily were placed under the Bourbon royal family, which had ruled the areas earlier. These regions together were called the kingdom of the Two Sicilies. Most of the Papal States were returned to the pope. In the north, several states ruled by dukes loyal to Austria were reestablished. Lombardy and Venetia were placed under direct Austrian rule.

Austria controlled much of the Italian peninsula more firmly than ever before. But talk of reform continued, particularly among lawyers, professors, and liberal noblemen. Piedmont became the center of this movement, and Piedmont's rulers, the kings of the Kingdom of Sardinia, were a focus of Italian political hopes. Giuseppe Mazzini, an Italian patriot, began to work actively for national unity and an independent Italian republic. During the 1820's and early 1830's, a number of unsuccessful revolts took place against the local rulers.

Italy united. In 1848, revolutions broke out in Austria, in France, in many of the German states, and in every major Italian city. The king of the Kingdom of Sardinia and the king of Naples each granted a constitution to his people. The citizens of Milan drove out the Austrian army. Venice again declared itself a republic. Republics were also established in Rome and in Tuscany. But these governments were too inexperienced and divided to oppose Austria.

In 1849, Austria put down the revolutions. The Kingdom of Sardinia was defeated and King Charles Albert gave up his throne to his son, Victor Emmanuel II. The king of Naples rejected the constitution he had been forced to grant. He jailed the revolutionists and governed harshly. The grand duke returned to his throne in Tuscany. With aid from the French army, the pope reestablished his control in Rome. The republics in Tuscany and Rome were thus ended. After a year of fighting the Venetian Republic, the last of the revolutionary governments, surrendered to Austria. The revolutions were over, and Austria kept control of much of Italy.

Many Italians now realized that they would have to expel the Austrians to get the reforms they wanted. The Kingdom of Sardinia had kept its constitution and its tricolor flag, the symbol of Italian patriotism. Count Cavour, the prime minister of the Kingdom of Sardinia, tried to establish his country as a progressive, independent state. He sought a place for it in European councils as the spokesperson for Italy against Austria.

Most Italian patriots made national unity under the king of the Kingdom of Sardinia their goal. In 1858, Cavour arranged a defense agreement with Napoleon III of France. Austria feared losing its hold on Italy, and declared war on the Kingdom of Sardinia in 1859. Soldiers from France and Italy pushed the Austrians eastward almost to Venice. The dukes who had ruled in cooperation with Austria were expelled by local revolts.

In 1859 and 1860, all of northern Italy, except Venetia, down to the Papal States was joined to the Kingdom of Sardinia. This territory was far more than Napoleon III had wanted the Kingdom of Sardinia to gain, but it was less than the Italians had demanded. In 1860, Giuseppe Garibaldi, Italy's most popular hero, sailed to Sicily with a thousand volunteers to help fight for Sicily's freedom

WORLD BOOK map

The unification of Italy began in 1859, as parts of the Italian peninsula joined with the Kingdom of Sardinia. The expanded kingdom became the Kingdom of Italy in 1861. The dates on this map indicate when each region joined the kingdom.

Pictorial Parade

Giuseppe Garibaldi and his volunteer army triumphantly entered Messina in July 1860, after conquering Sicily for the Kingdom of Sardinia.

against its Bourbon rulers. Garibaldi's small, enthusiastic army, called the "red shirts," defeated the far larger professional army of the Kingdom of the Two Sicilies. Then Garibaldi's troops crossed to the Italian mainland and captured southern Italy and the city of Naples. Cavour sent an army through the Papal States to join Garibaldi and to keep him from attacking Rome. Cavour feared that an attack on Rome would make France or Austria come to the aid of the pope. Cavour also feared Garibaldi might use his popularity to win support for a republic instead of a monarchy.

The Kingdom of Italy. Supported by a nationwide vote, Victor Emmanuel II declared the formation of the Kingdom of Italy in 1861. It included all the peninsula except Venetia, the tiny country of San Marino, and the city of Rome. Victor Emmanuel II, the king of the Kingdom of Sardinia, became king of Italy.

In 1866, Victor Emmanuel agreed to support Prussia in a war against Austria. In return for his support, Italy was to receive Venetia if Prussia defeated Austria. The war began in June 1866, and Austria was defeated by July. Venetia became part of Italy. Only Rome and San Marino were not part of the new kingdom.

War between France and Prussia in 1870 led France to withdraw the French troops that were protecting Rome for the pope. The Italian army moved into Rome, and Italy at last included the entire peninsula. The pope's territory was reduced to the Vatican and Lateran palaces and the papal villa at Castel Gandolfo. Rome became the capital of Italy in 1871.

The Kingdom of Italy had many problems. An enormous debt remained after the wars that were fought to unite the country. Italy had few resources, and it lagged behind the other major powers in industrialization. Economic and social differences between the industrial north and the rural south were added problems. Regional disputes showed that national unity was far from complete. Many people in other regions did not like being ruled by the Piedmontese leaders of the Kingdom of Sardinia. The pope was angry about the loss of Rome and the Papal States, and refused to accept the legality of the new nation. He forbade Roman Catholics from taking part in national elections. In addition, Parliament did not represent all the people because only the wealthy were allowed to vote. Socialist and labor movements began to organize in all parts of the country.

From 1870 to 1915, Italy made important progress economically and socially. Working conditions improved, production of goods increased, and many more people learned to read and write. In spite of these improvements, the government failed to win the confidence and support of its citizens.

The Italian government also had difficulty with its foreign policy and wanted to increase Italy's influence in world affairs. In 1882, Italy became part of the Triple Alliance, along with Austria-Hungary and Germany. Italy hoped to obtain a colonial empire in North Africa to make the government more popular at home. Between 1887 and 1896, Italy made several unsuccessful attempts to conquer Ethiopia and colonize it.

In 1911, Italy declared war on the Ottoman Empire over the rights of Italians living in Libya. Libya was then a part of the Ottoman Empire in North Africa. Italy defeated the Ottoman Empire, and in 1912, the Ottomans signed a treaty that gave Libya and the Dodecanese Islands to Italy.

World War I began in 1914. Germany and Austria-Hungary were eager to have Italy's support against the Allies—France, Britain, and Russia. But Trieste and Trentino, the territories Italy wanted most, belonged to Austria, and Italy's relations with France were friendly. Italy stayed out of the fighting for almost a year, even though it belonged to the Triple Alliance.

The war became another source of political division in Italy. Some Italians favored neutrality, but others wanted to support the Allies. Finally, in 1915, Italy entered the war on the side of the Allies. The Allies promised in a secret agreement that if they won the war, they would give Italy Trieste and Trentino, and portions of Albania, Dalmatia, and Istria. They also promised financial aid and territory in Africa. For the story of Italy in the war, see **World War I**.

The battles against Austria along Italy's northeast border turned out to be more expensive in men and materials than expected, and they settled little. In two years of bloody fighting, the Italian army moved only about 10 miles (16 kilometers) into Austrian territory. Then, in 1917, German and Austrian troops began an attack that forced the Italians to retreat. With the aid of the Allies, Italy rallied. The Italian army was reorganized and won some important victories before the war ended in 1918.

The treaties following the end of World War I were unsatisfactory to Italy. They gave Italy nearly 9,000 square miles (23,000 square kilometers) of important territory that had belonged to Austria-Hungary, including Trentino and Trieste. But this territory was far less than the Allies had promised.

Italy under Mussolini. World War I left Italians still more dissatisfied with their government than they had been before. Thousands of workers had no jobs. Veterans were bitter that they had gained so little for their sacrifices. The Italian election of 1919 was the first in which all adult males were allowed to vote. It produced great victories for two new mass parties, the Popular Party—which was linked to the Roman Catholic Church—and the Socialist Party. These parties opposed each other and criticized government officials. Conflicts between the different parties in Parliament prevented the development of effective national leadership. Workers began to strike, peasants demanded land, and threats of revolution grew.

A new movement called *Fascism,* led by Benito Mussolini, a former Socialist, grew increasingly popular (see **Fascism**). The Fascists favored strict government control of labor and industry. They promised to bring order to Italy and to make the nation great. In October 1922, they marched on Rome, and King Victor Emmanuel III named Mussolini prime minister of Italy.

By 1925, Mussolini ruled Italy as dictator. Italian Fascism became a model for similar movements in Europe and Latin America. The Fascists organized young people, workers, and employers into groups pledged to support Mussolini, who was called *Il Duce* (The Leader). The Fascists used terror and secret police to prevent opposition. They controlled the press, radio, and schools and used propaganda skillfully. Public works projects, the apparent sense of order, and growing military strength impressed many foreigners as well as Italians.

One of Mussolini's best-known achievements was the Lateran Treaty of 1929. This treaty established normal relations between the Roman Catholic Church and the Italian government for the first time since Italy took over Rome in 1870. See **Papal States.**

World War II. From 1935 to 1945, Italy was at war almost continuously. In 1936, Mussolini conquered Ethiopia. In 1936, he sent almost 70,000 men to help the rebels under Francisco Franco win the Spanish Civil War. Later that year, Mussolini and Adolf Hitler, the German dictator, signed an agreement which outlined a common foreign policy for Germany and Italy. This agreement became known as the *Rome-Berlin Axis* to suggest that all Europe rotated around a line between the two capitals. In 1939, Italian troops seized Albania.

Also in 1939, Italy agreed to fight on Germany's side in case of war. World War II began on Sept. 1, 1939, when Hitler's troops marched into Poland. The United Kingdom and France immediately declared war on Germany. But Italy stayed out of the fighting for more than nine months. On June 10, 1940, less than two weeks before France fell to Germany, Italy entered the war.

UPI/Bettmann

During World War II, anti-Fascists in Rome rounded up Fascist leaders for trial after Allied forces freed the city in 1944. The captive shown here, *with folded hands,* pleads his innocence.

Italy was unprepared economically or militarily for modern war, and Mussolini's campaigns went poorly. The Italian army suffered defeats in North Africa, Ethiopia, Eritrea, and Greece. The Allies invaded Sicily on July 10, 1943. Under orders from King Victor Emmanuel III, the Italian government overthrew and imprisoned Mussolini. German commandos rescued Mussolini, and he fled to northern Italy. The Allies landed on the Italian mainland on September 3, and Italy surrendered that same day. On October 13, Italy declared war on Germany. But German forces took control of Italy and installed Mussolini as head of a puppet government. As the Allies moved northward, civil war broke out between the remaining Fascist forces and the *Resistance,* a growing movement of anti-Fascist, anti-Nazi Italians. In 1945, members of the Resistance caught and shot Mussolini when he tried to escape to Switzerland. A number of these underground fighters, called *partisans,* were members of the Communist Party. The partisans became increasingly influential after the war. See **World War II.**

Allied troops left Italy after a peace treaty was signed in 1947. Italy lost such possessions as the Dodecanese Islands, Eritrea, and Libya. In 1949, Italian Somaliland was made a United Nations trust territory for 10 years, and was also placed under Italian administration.

The Italian republic. Between 1945 and 1948, the outlines of a new Italy began to appear. Victor Emmanuel III gave up the throne on May 9, 1946, and his son, Umberto II (also spelled Humbert), became king. On June 2, Italy held its first free election in 20 years. Italians chose a republic to replace the monarchy, which had been closely associated with Fascism. They elected a Constituent Assembly to prepare a new democratic constitution. The Assembly adopted the constitution in 1947.

Three political parties—the Christian Democrats, the Socialists, and the Communists—became the most powerful in the Italian republic. For many years, the Christian Democrats ruled the country, usually in coalitions with smaller parties.

Prime Minister Alcide De Gasperi, head of the Christian Democrats, was the most powerful figure in the government from 1948 to 1953. De Gasperi held together the various groups in his party and excluded the Communists from the government. He established programs of industrial growth and agricultural reform. Under his leadership, Italy formed closer ties with the United States and with other Western European nations. In the late 1940's and early 1950's, Italy depended heavily on economic aid from the United States. In 1949, Italy became a founding member of the North Atlantic Treaty Organization (NATO). Italy became a founding member of the European Payments Union (now the European Monetary Agreement) in 1950.

After De Gasperi's death in 1954, divisions among the Christian Democratic majority widened, allowing the other parties greater influence. Despite its large size, the Communist Party was kept out of positions of power in the government. Italy became a member of the United Nations in 1955. Also in the 1950's, Italy helped establish several organizations that eventually became the European Community, an economic association that was incorporated into the European Union in 1993. During the 1950's, the Italian economy began to grow impressively. By the 1960's, industrial production had reached more than twice its prewar level, and Italy's rate of economic growth ranked among the highest in Europe. Italy had quickly been transformed from a nation in which most people worked in agriculture to one in which industry formed the backbone of the economy.

The rapid changes in Italy's economy also brought many problems. Most of the economic growth occurred in the north. As a result, the gap between the poor regions of the south and the prosperous regions of the north increased, in spite of government aid to the south. Housing shortages developed in major cities. Social questions centering on the condition of the poor and the workers' share in the nation's growing prosperity became increasingly important.

In 1962, rising demands for social reforms in a changing society led to an important shift in Italy's government. That year, a political agreement called the *opening to the left* gave the Socialists a role, along with the Christian Democrats, in the governing coalition. With minor changes, this coalition lasted until the Socialists withdrew in 1976. During this period, government reforms made the tax system fairer, opened higher education to more students, and established regional governments with increased authority. The Socialists rejoined the coalition in 1980.

Economic problems and political changes. In 1969, strikes and protests by labor union members led to increased wages and benefits for workers. But inflation, caused largely by a worldwide rise in the cost of petroleum, soon became a serious problem. The price increase hit Italy especially hard because the nation must import most of its petroleum. Continuing pressure from labor unions for increased wages and benefits added to the inflation problem, as did the government's reluctance or inability to raise taxes. At the same time, the government increased its own economic burdens by taking over many faltering and unprofitable firms. As Italy's economic problems grew, the government found it increasingly difficult to win support and pursue consistent policies. Many Italians accused government agencies of inefficiency and incompetence.

During the 1970's, the Communists significantly increased their voice in Italian politics. Locally, they won control of many regional and city governments. They carried out extensive social reforms that the national government was unwilling to attempt. Nationally, the vote for the Communist Party reached a level only slightly below that for the Christian Democrats. No other party compared with these two in size and influence.

The Italian Communists became increasingly independent of Soviet and Eastern European Communism. They insisted that they were loyal to democracy and should have a voice in national policy. By the mid-1970's, Italy's Christian Democratic government depended on a promise by the Communists not to vote against the government on major issues. In 1977, the Communists agreed to support the government in return for a role in setting policy. But the Christian Democrats continued to exclude Communists from the cabinet. By the 1980's, the Communist vote had begun to decline.

Social problems. Cooperation with the Communists enabled the government to take stronger measures to limit inflation and strengthen the economy. But this cooperation was unpopular with many Christian Democrats and with some of Italy's allies, especially the United States. It also brought a wave of violent opposition from right-wing neo-Fascists and from the Red Brigades, a small group of leftist terrorists who oppose all the Italian political parties. The Red Brigades created fear and disruption by bombing public places and shooting leading business executives and government officials.

In 1978, the Red Brigades kidnapped Aldo Moro, a former prime minister who was expected to become Italy's next president. Moro had played a central part in promoting cooperation between the Christian Democrats and the Communists. The Red Brigades offered to free Moro in exchange for the release of their members who had been arrested for terrorism. But Italian leaders rejected the terrorists' offer. After seven weeks of waiting, the terrorists killed Moro. Reaction to this murder led to a renewed drive against the terrorists, resulting in the arrest and conviction of hundreds of people.

During the late 1960's, the political influence of the Roman Catholic Church in Italy had begun to weaken. In 1970, the Italian Parliament went against the position of the church and voted to legalize divorce. In 1978, it voted to allow abortions, resisting intense opposition from the church. In 1984, the government and the church agreed to end a 1929 provision that had made Roman Catholicism the state religion of Italy. The agreement won the approval of Parliament in 1985.

Organized crime has long been a problem in Italy. Organized crime activities range from international drug trafficking to corruption in awarding government construction contracts. In 1982, General Dalla Chiesa, head of the government's efforts against the Mafia, a criminal organization in Sicily, was assassinated. In 1986, the government began the mass prosecution of 452 accused

Mafia members in Palermo. About 340 were convicted.

Political changes. In 1981, Republican Party leader Giovanni Spadolini became prime minister. He was the first prime minister of Italy since the end of World War II who was not a Christian Democrat. Bettino Craxi of the Socialist Party succeeded Spadolini in 1983 and served until 1987. His government lasted longer than any other since the Italian republic was set up in 1946. Italy enjoyed renewed prosperity during his tenure. In the early 1990's, many Italian political and business leaders were indicted for bribery and other corruption charges. Craxi was convicted on graft and corruption charges, but he had fled the country and was never arrested.

Italy's Communist Party became troubled by problems of policy and leadership. In 1991, after years of moving slowly away from Communist principles, it changed its name to the Democratic Party of the Left. Some of the members opposed this trend and formed a new, small Communist Party called the Communist Refoundation.

Christian Democrats held the office of prime minister from 1987 to 1992. Other parties held the office in coalition governments from 1992 to early 1994, but Christian Democrats continued to hold the largest number of cabinet posts. In January 1994, the Christian Democratic Party changed its name to the Popular Party. In March, the Alliance for Freedom, a right-wing coalition of several parties, won the largest number of seats in Parliament.

Recent developments. In 1996, Olive Tree, a left-wing coalition led by the Democratic Party of the Left, won the most seats in Parliament. Olive Tree's victory put former Communists in power for the first time in Italy's history. In late 1998, the coalition collapsed. The Democrats of the Left formed a new coalition with the Green Party and the Democratic Union for the Republic.

In 1999, Italy and most other members of the European Union adopted a common currency called the euro. In 2002, euro coins and notes replaced Italy's own currency, the lira.

Elections in 2001 brought the House of Liberties coalition to power. This center-right coalition was led by wealthy businessman Silvio Berlusconi, who became Italy's new prime minister.

John A. Davis

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VIII. History

Questions

What is Italy's most important farming region?
How did Italy get its name?
When was the Italian peninsula united under one government?
What territory did Italy hope to gain in World War I?
What are the most popular recreational activities in Italy?
What languages besides Italian are spoken in Italy?
What are the leading economic activities in Italy?
What is Italy's leading manufacturing industry?

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Itch. See Skin (Skin disorders).

Itch mite. See Scabies.

Iturbide, *ee toor BEE thay,* Agustín de, *ah goos TEEN day* (1783-1824), a Mexican military leader, ruled Mexico from May 1822 to March 1823 as Emperor Agustín I. In 1821, Iturbide helped originate the "Plan of Iguala," which proposed that Mexico, then a colony of Spain, become an independent kingdom under a Spanish Bourbon prince. The plan converted many of Mexico's conservatives to the cause of independence.

Iturbide was born on Sept. 27, 1783, in Valladolid (now Morelia), Mexico. When Mexico's War for Independence began in 1810, he became a Spanish army officer. By 1820, he commanded Spain's northern army. But Iturbide became a supporter of Mexican freedom and sought peace through the Plan of Iguala. Mexico became independent in 1821. Despite opposition, Iturbide became emperor. No suitable European monarch had accepted the crown. A rebellion soon broke out, and Iturbide had to give up his title. He was allowed to go to Europe. A year later, he tried to return and fight for his throne, but he was arrested and shot. W. Dirk Raat

See also Mexico (Independence).

Ivan III, the Great (1440-1505), was grand prince of Moscow from 1462 to 1505. He is considered Russia's first national leader.

Ivan was born on Jan. 22, 1440, in Moscow. He succeeded his father, Basil II. Before Ivan's reign, Russia was a divided country whose princes were often at war with one another. Russia was also part of the Mongol Empire. Ivan united Russia under his rule. He ended Mongol control of Russia in 1480. Ivan achieved these goals by being a ruthless warrior, a clever diplomat, and a shrewd buyer of land. Also under his rule, the Russian frontier began to extend east into Siberia.

In 1472, Ivan married Sophia Paleologa, niece of the last Byzantine emperor, Constantine XI. Sophia brought scholars, painters, and architects to Moscow, where they helped create a majestic court. In 1497, Ivan issued Russia's first law code. During his reign, he sided with the Russian Orthodox Church against critics who questioned church dogma and wealth. As a result, the church accepted greater control by the grand prince in return for his protection. James Cracraft

Ivan IV, the Terrible (1530-1584), in 1547 became the first Russian ruler to be crowned czar. Known for his cruelty, he created a stronger and more centralized government and expanded Russia's territory.

Ivan was born on Aug. 25, 1530, in Kolomenskoye, near Moscow. His grandfather was Grand Prince Ivan III of Moscow, also known as Ivan the Great. Ivan IV became grand prince in 1533 after his father, Basil III, died. Ivan was only 3 years old at the time, and for a number of years nobles fought to control the government.

After Ivan began to rule independently in 1547, he conquered vast lands southeast of Moscow along the Volga River and opened trade with England. In the 1560's, he established his personal, arbitrary rule in much of Russia. His political police terrorized nobles, merchants, and peasants. Ivan's laws helped bind many peasants to the land as serfs. In the 1580's, Russia's Stroganov family sponsored the conquest of western Siberia and gave it to Ivan to add to the realm. James Cracraft

See also **Russia** (Ivan the Terrible); **Serf.**

Iverson, Allen (1975-), ranks among the most exciting players in the National Basketball Association (NBA). Iverson is one of the smallest players in the NBA, standing only 6 feet (183 centimeters) tall and weighing only 165 pounds (74.8 kilograms). However, his speed and athletic ability have made him one of the NBA's top scorers. Iverson plays guard for the Philadelphia 76ers.

Iverson is particularly effective driving to the basket. He led the NBA in scoring for the 2000-2001 season with an average of 31.1 points per game and for the 2001-2002 season with an average of 31.4 points per game. Iverson also was named the NBA's Most Valuable Player for the 2000-2001 season.

Iverson became a controversial symbol of youth rebellion in the NBA with his cornrow hairstyle, tattoos, and baggy clothing. He was often criticized by the public and other players but gained widespread praise for his outstanding performance in the 2001 NBA play-off finals against the Los Angeles Lakers.

Iverson was born on June 7, 1975, in Hampton, Virginia. He starred at Georgetown University for two years before the 76ers made him the first selection in the NBA draft in 1996. Iverson was named the league's Rookie of the Year. Sam Smith

Ives, Charles Edward (1874-1954), was a leading American experimental composer. Ives composed his most important music from 1896 to 1921. However, he remained almost unknown until the last years of his life. Some of Ives's major works were not introduced to the public until after his death. Today, Ives ranks as one of the greatest and most original American composers.

In his compositions, Ives emphasizes American folk and popular music, such as ragtime, military marches, patriotic songs, and revival hymns. Ives based some of his music on such subjects as baseball. One of his 27 piano pieces is called *Some Southpaw Pitching* (1908).

Ives was born on Oct. 20, 1874, in Danbury, Connecticut. Some of his works suggest circus parades and revival meetings that reflect his memories of life in New England. Ives founded an insurance firm in 1909 and became a successful executive. He composed at night, on weekends, and during holidays and vacations. A few of Ives's compositions were performed as early as 1925. But most people who enjoyed experimental music did not become aware of his work until about 1939.

Ives wrote more than 160 songs and many choral works. His chamber music includes Sonata No. 4 (1916?) for piano and violin, known as *Children's Day at the Camp Meeting;* and *Hallowe'en* (1906) for piano and string quartet. One of Ives's four symphonies, Symphony No. 3 (1904), won the 1947 Pulitzer Prize. Ives's other works include *The Unanswered Question* (1906) for trumpet, flutes, and strings; and *Three Places in New England* (1908-1914?) for orchestra. Richard Jackson

Ives, James Merritt. See Currier and Ives.

Ivory is a hard substance that makes up the main part

of the tusks and teeth of certain animals. The tusks of the African elephant are the major source of ivory. Other ivory comes from tusks of the walrus, narwhal, and fossilized prehistoric mammoths and from teeth of the hippopotamus and sperm whale. Polished ivory has been prized for centuries for its luminous beauty. It has been carved into decorative objects and works of art and used to make piano keys and billiard balls.

Characteristics of ivory. Ivory varies in color from white to pale pink, yellow, or tan. It is a kind of *dentin,* a bony material beneath the enamel of a tusk or tooth. Sculptors sometimes carve the enamel along with the dentin. In other cases, the enamel is too hard and must be stripped away before carving can begin. Ivory is tough and durable, but it will crack if exposed to extremely hot or cold temperatures. It also should be kept in a place that is not too moist or dry. Ivory is easy to polish and keep clean.

Ivory carving began in prehistoric times, about 20,000 B.C. But ivory objects were not produced in large numbers until about 8000 B.C., when Egyptians established workshops for ivory carvers. The art form spread throughout the Middle East and to lands along the Mediterranean Sea. In ancient times, people considered ivory as precious as gold and gems. People living in Egypt from the 2800's to the 2600's B.C. decorated caskets and furniture with ivory. The ancient Greeks carved huge *chryselephantine* (gold and ivory) statues of gods and goddesses. The Romans made ivory combs, buttons, hair ornaments, furniture, and writing tablets.

Ivory carving flourished in Europe from the A.D. 500's through about 1000. Artists of the Byzantine Empire carved *reliefs* (raised designs on a flat surface) with Christian themes onto plaques, tablets, and caskets. Sculptors and carvers in what is now France and Germany continued the tradition of creating beautiful reliefs. By the 1200's, artists resumed production of such nonreligious ivory objects as combs and book covers.

Ivory carving declined during the 1400's and 1500's because the ivory trade routes from the East were blocked by the Turkish Empire. The use of ivory revived in the 1600's and 1700's after Europeans discovered new sources in Africa. Artists carved elaborate designs portraying mythological themes onto such objects as boxes, drinking mugs, plaques, and vases. In the 1800's, sculptors and hobbyists took up ivory carving, creating small statues, model ships, and game pieces.

In North America during the 1800's, sailors were an important source of ivory carving. They made small carvings or engravings on whale teeth, whalebone, and sea shells. Such carvings are called *scrimshaw.*

In Asia, the Chinese were the first people to develop ivory carving as an art form during the Shang dynasty (about 1766 to 1122 B.C.). During the Tang dynasty (A.D. 618 to 907), Chinese artists made beautiful carvings for both religious and personal use among the aristocracy. Chinese artists of this period influenced the work of Japanese sculptors, who made small decorative objects with delicate patterns. In the 1700's, Japanese artists introduced the carved *netsuke,* a tiny ornamental figure that was strung through a cord tied around the waist.

Ivory today. During the second half of the 1900's, the world's ivory supply became increasingly scarce as the African elephant population declined. Many elephants have been driven from their natural habitats by people who took over the land. Hundreds of thousands of elephants have been illegally killed by poachers who profit from the sale of the tusks. In 1989, all trade in ivory and other elephant products was banned by the Convention in Trade in Endangered Species (CITES), an international agreement administered by the United Nations. However, in 1997, CITES members agreed to allow Botswana, Namibia, and Zimbabwe to sell limited amounts of ivory to Japan. In 1999, stockpiled ivory from these three nations was auctioned to Japanese buyers. John W. Keefe

Ivory Diptych with Apostles (about A.D. 500); Christian Museum, Brescia (SCALA/Art Resource)

Horse (about 20,000 B.C.); Musée des Antiquités Nationales, St. Germain-en-Laye, France

Netsuke (1700's-1800's); Seattle Art Museum, Duncan MacTavish Fuller Memorial Collection (Paul Macapia)

Carved ivory objects include a pair of early medieval hinged plaques, *top;* a prehistoric figure of a horse, *above left;* and a Japanese ornament called a *netsuke, above right.* A netsuke is strung through a cord that is worn around the waist.

For pictures of carved ivory, see **Africa** (The arts); **Byzantine Empire**; and **Folk art** (Scrimshaw). See also **Elephant** (Introduction; Protecting elephants).

Ivory black is a black pigment made by heating waste ivory dust and chips. It is chiefly used as a coloring agent in oil paints. The term sometimes is erroneously applied to *boneblack,* a powder made from burnt bones. George J. Danker

Ivory Coast. See Cote D'Ivoire.

Ivory palm is a short palm tree native to South America. It is also called the *ivory-nut palm* because its seeds were once used as ivory substitutes. The tree grows slowly and has a very short trunk.

The ivory palm has slender, featherlike leaves, and bears fragrant flowers. The plants are either male or female. The female flowers grow on a stalked head that eventually forms a large, tight cluster of wartlike fruits. Each fruit bears from six to nine seeds. When the fruit ripens, the lower part splits open and the *negritos* (seeds) fall to the ground. The unripe seeds are good to eat. But when they mature, they become hard and white. Then the seed looks so much like ivory that it is called *vegetable ivory.* Vegetable ivory was once an important substitute for ivory. It was used for buttons, chessmen, and small ornaments. It absorbs dyes easily, and takes a high, permanent polish. Vegetable ivory is also easy to carve. James D Mauseth

© A-Z Collection

The graceful ivory palm grows in South America. The slender leaves that fan from the branches resemble ostrich plumes.

Naud, AAA Photo

© Loren A. McIntyre

An ivory palm pod produces seeds that become hard and white when dry. Decorative objects are made from them.

Scientific classification. The ivory palm belongs to the palm family, Arecaceae or Palmae. Its scientific name is *Phytelephas macrocarpa.*

Ivy is any one of a large number of creeping or climbing vines. These vines have different botanical names, and the word *ivy,* as commonly used, does not belong to any one plant. It often applies to climbing vines, especially to those that are ornamental.

English, or common, ivy is the attractive evergreen plant commonly seen climbing over walls and tree trunks in Europe and North America. Its waxy leaves usually have five points, or angles. They are generally dark green all year, but sometimes have a bronze color in the fall and winter. English ivy also bears tiny flowers. This ivy clings to smooth surfaces with the fine roots on its stems. It does not grow well in the bright sun of the central, southern, and western United States. But in shady locations, it can be grown as far north as Ontario, Canada. It makes an excellent covering for buildings. Its leaves and berries are poisonous.

Boston, or Japanese, ivy is the climbing vine often found covering the shady sides of buildings like a lovely green carpet. It usually grows in the eastern United States, and in Asia and Europe. The covering is made of many overlapping leaves, each with three points. Each fall, the leaves turn red and are shed. Boston ivy belongs to the same genus as the Virginia creeper.

Ground ivy is also called *gill-over-the-ground.* It was brought to North America from Europe. This trailing, fragrant plant has creeping stems that form thick masses of leaves wherever they get a foothold. Its leaves are rounded with coarse edges, and its tube-shaped flowers are purple or blue. The ground ivy was formerly used in making ale and cough medicine. It has also been popular with some landscape gardeners, though it can be a troublesome weed in North America.

Poison ivy and Virginia creeper. These two plants look somewhat the same, but they belong to different families. They are both American vines, and often grow in the same locality. It is easy to confuse the two. The leaves of the Virginia creeper, however, are made up of five leaflets, while those of poison ivy have only three.

© Giuseppe Mazza

English ivy is popular both as an indoor houseplant and as an outdoor ground cover or a vine that covers walls. It has a number of forms, including true English ivy, *above,* and Algerian ivy, *left.*

Poison ivy leaves are covered with an oil that often causes itching and blisters on the skin of people who touch them. This oil also may be brushed onto the clothing of people coming in contact with poison ivy plants. The leaves are red in early spring and shiny green from late spring through summer. They turn red or orange in autumn. Virginia creeper is harmless. Theodore R. Dudley

Scientific classification. English ivy belongs to the ginseng family, Araliaceae. Its scientific name is *Hedera helix.* Boston ivy belongs to the family Vitaceae. Its scientific name is *Parthenocissus tricuspidata.* Ground ivy belongs to the mint family, Lamiaceae or Labiatae. Its scientific name is *Nepeta hederacea.*

See also **Poison ivy; Virginia creeper.**

Iwo Jima, *EE woh JEE muh,* is the middle island of the three Volcano Islands, or Kazan Retto, in the northwestern Pacific Ocean. More than 6,000 men, including more than 5,800 men of the Third, Fourth, and Fifth United States Marine divisions, died in capturing its 8 square miles (21 square kilometers) from the Japanese in February and March, 1945. The capture of Iwo Jima was of great help to the American forces in the last stages of the war against Japan.

Before Iwo Jima was captured, Japanese fighter planes had attacked United States bombers from there. After American forces won the island, United States fighter planes used the airstrips to protect bombers flying from Saipan and Tinian to Japan. Iwo Jima fields also served as emergency landing places for B-29 bombers returning from raids on Japan.

Iwo Jima is about 5 miles (8 kilometers) long and 2 $\frac{1}{2}$ miles (4 kilometers) wide at its widest point. It is shaped somewhat like the continent of South America. At the southern end is Mount Suribachi, a volcano. The northern part of the island has hills with deep gulches. The soil on the island is made of gray volcanic ash. It was soft enough for the Japanese defending Iwo Jima during the war to dig extensive underground fortifications.

Iwo Jima is Japanese for *Sulfur Island.* Before World War II, sulfur was mined on the island. About 1,000 Japanese lived there at that time. They planted cotton, sugar cane, cacao, coffee, and vegetables. The soil is so porous that there are no streams, and water is scarce. Civilians were removed before the war. The United States controlled the island until 1968, when it was returned to Japan. Robert C. Kiste

See also **Pacific Islands** (map).

United Press Int.

Flag raising on Iwo Jima is one of the most famous pictures of World War II. It served as a model for the United States Marine Corps War Memorial in Washington, D.C. Photographer Joe Rosenthal of the Associated Press won a Pulitzer Prize in 1945 for this picture. The flag raisers shown in the front of the picture are, *left to right,* Ira H. Hayes, Franklin R. Sousley, John H. Bradley, and Harlon H. Block. Two other men, Michael Strank and Rene A. Gagnon, are barely visible behind Sousley and Bradley.

Ixtacihuatl, *EES tah SEE waht uhl,* is an inactive volcano about 35 miles (56 kilometers) southeast of Mexico City. The name is also spelled *Iztaccihuatl,* (pronounced *ees tahk SEE waht uhl*). *Ixtacihuatl* means *white woman* in the Aztec language. The volcano's name comes from its broken, snow-covered *crest* (outline), which resembles the head, breasts, and feet of a sleeping woman covered by a white blanket.

Keith Gunnar, Bruce Coleman Inc.

Ixtacihuatl is a beautiful inactive volcano near Mexico City. *Ixtacihuatl* means *white woman* in the Aztec language. The Aztec people named the volcano Ixtacihuatl because its outline resembles the head, breasts, and feet of a sleeping woman covered by a white blanket.

Ixtacihuatl's highest peak reaches an altitude of 17,343 feet (5,286 meters). The volcano is covered by a thick layer of hardened lava called *andesite.* The absence of *basalt,* another kind of lava, indicates that the volcano has long been inactive. Ixtacihuatl lies about 10 miles (16 kilometers) north of the active volcano Popocatépetl.

John J. Winberry

See also **Mountain** (picture: chart).

Izaak Walton League of America is one of the oldest conservation organizations in the United States. It was formed in 1922 in Chicago. Today, the league has more than 50,000 members, who work to protect the country's soil, air, woods, waters, and wildlife. The

© Jay Clark, IWLA

Izaak Walton League of America volunteers monitor a stream in Maryland to make certain it is clean and safe. The league is an important conservation organization in the United States.

league takes its name from English author and conservationist Izaak Walton. Walton wrote *The Compleat Angler* (1653), a book about the joys of fishing and the responsibility of conserving natural resources.

The league's major goals include:

(1) Keeping lakes, streams, and ground water safe for drinking, swimming, fishing, and wildlife. The league conducts more than 2,500 stream-testing and cleanup projects.

(2) Protecting wetlands and other wildlife habitats. The league works to maintain healthy and diverse wildlife populations.

(3) Protecting water quality and wildlife on public lands. The league advises ranchers, foresters, and government agencies about managing public lands.

(4) Helping conserve farmland. The league encourages farmers to control soil erosion, limit the use of pesticides that pollute ground water, and set aside lands that erode easily for wildlife habitat.

(5) Protecting parks, forests, and other lands from irresponsible commercial development. The Izaak Walton League Endowment buys endangered lands and often turns them over to national park and forest services.

(6) Promoting respect for and access to recreational areas. The league works with recreation clubs and government agencies to improve the behavior of people using recreational lands.

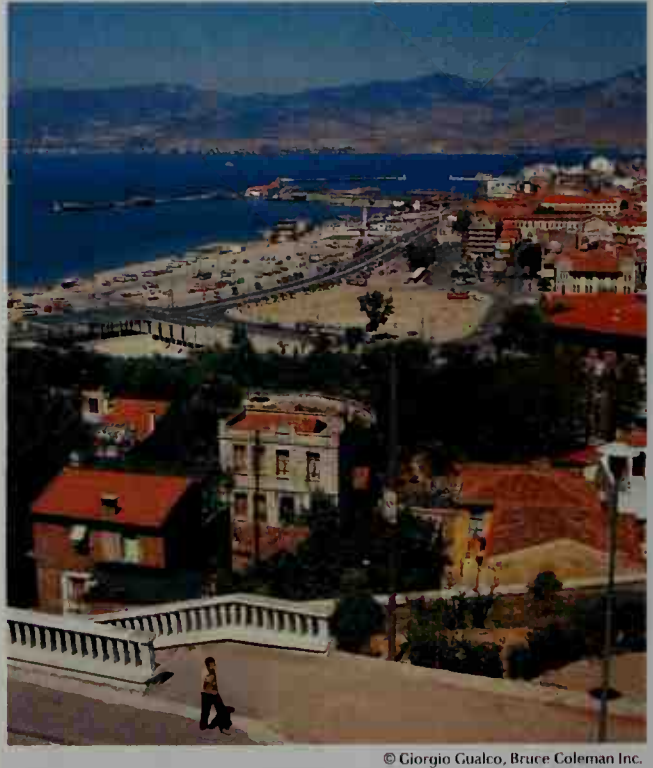
To achieve its goals, the league involves people in conservation projects and educates them about environmental threats. It also pushes for environmental protection laws and government funding for conservation. In addition, it sues violators of environmental laws.

The league has 400 local chapters, 20 state divisions, and several regional programs. It is an independent, nonprofit organization supported by membership dues, grants, gifts, and bequests. The league's national headquarters are in Arlington, Virginia.

Critically reviewed by the Izaak Walton League of America

See also **Walton, Izaak.**

Izmir, *IHZ meer* or *ihz MIHR* (pop. 1,757,100), is a Turkish port and trading center. It lies on the country's west coast, along the Aegean Sea (see **Turkey** [political map]). The Greek name for the city is Smyrna. Izmir exports chrome ore, tobacco, dried fruits, cotton, and olive oil. Since the 600's B.C., many different peoples have ruled the city. These have included Greeks, Romans, Seljuk Turks, Mongols, and Ottomans. In 1919, after World War I, Greek troops occupied Izmir. In 1922, Turkish nationalists forced the Greeks to leave. Izmir became part of the Republic of Turkey when the republic was established in 1923. See also **Turkey** (After World War I); **Sevres, Treaty of.** F. Muge Gocek



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Izmir is one of Turkey's leading ports, and a transportation and trading center. The city lies on the country's west coast, along a sheltered bay on the Aegean Sea.

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